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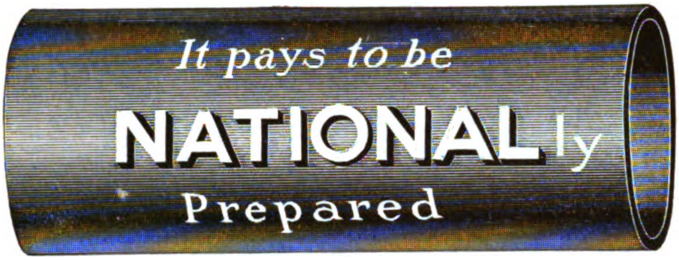

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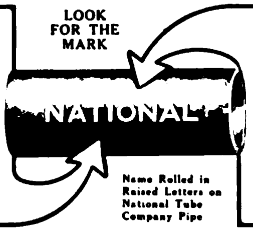

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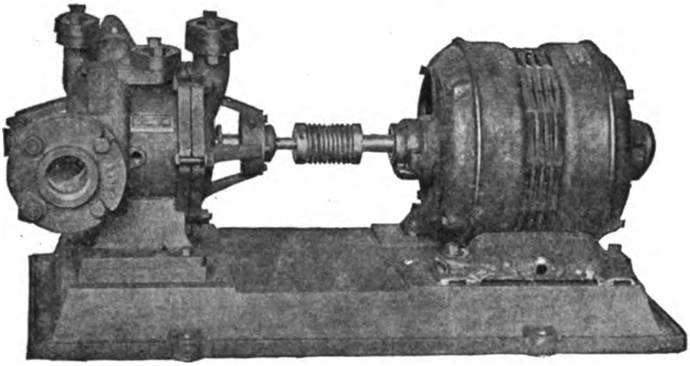

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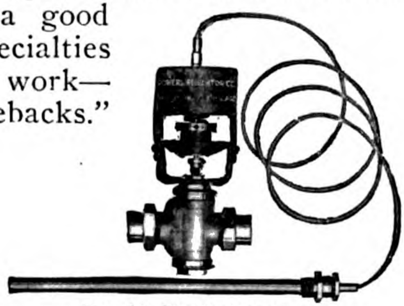

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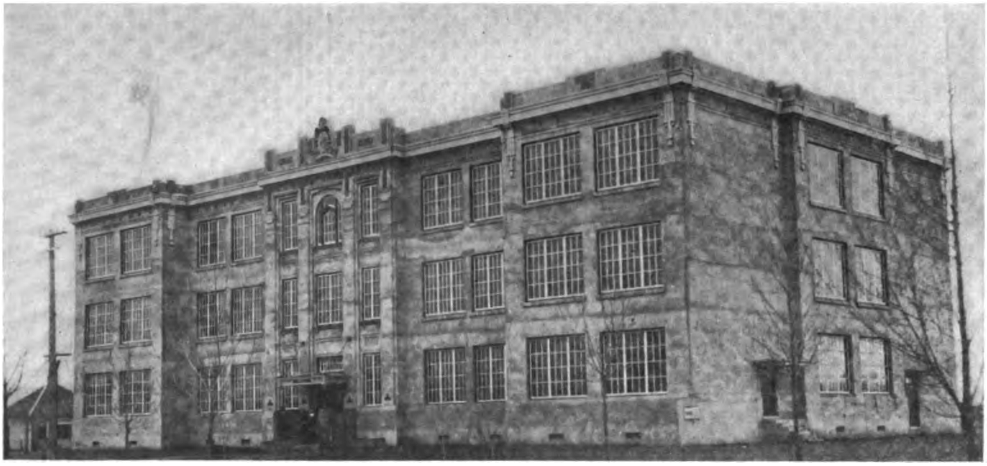


BURLEY HIGH SCHOOL, BURLEY, IDAHO.

Electric Heating for a Large High School

DETAILS OF THE NOTABLE PLANT INSTALLED AT BURLEY, IDAHO.

In THE HEATING AND VENTILATING MAGAZINE for May, 1914, a description was published of the Rupert "electric" high school, at Rupert, Idaho, in which electricity is used throughout as the heating medium. The electric current for this building comes from the Government power house at Minidoka Dam, 14 miles above Rupert on the Snake River. It is distributed by the Rupert Electric Company and sold at $1.00 per kilowatt per month.

Another school building located on the Minidoka Project, one of the United States Reclamation Service Projects, is the high school at Burley, Idaho, and this building has now been equipped with a similar type of electric-heating plant. It is a larger proposition than the Rupert plant and, indeed, is said to be the largest plant of its kind in the world.

The high school was built during the past summer and was completed for occupany, September 14, 1915. The building is of concrete, with an overall length of 165 ft. and a depth of 127 ft. It is three stories high, with nothing below the ground level except the gymnasium and the heating plant rooms. The building was planned by C. Lewis Wilson & Co., of Butte, Mont., working with J. J. Rae, superintendent of schools at Burley.

ELECTRIC HEATING SYSTEM CHOSEN AFTER INSPECTION OF RUPERT PLANT.

The board of trustees chose the electric heating system after investigating the electric heating plant at Rupert, Idaho, which is within nine miles of Burley. The

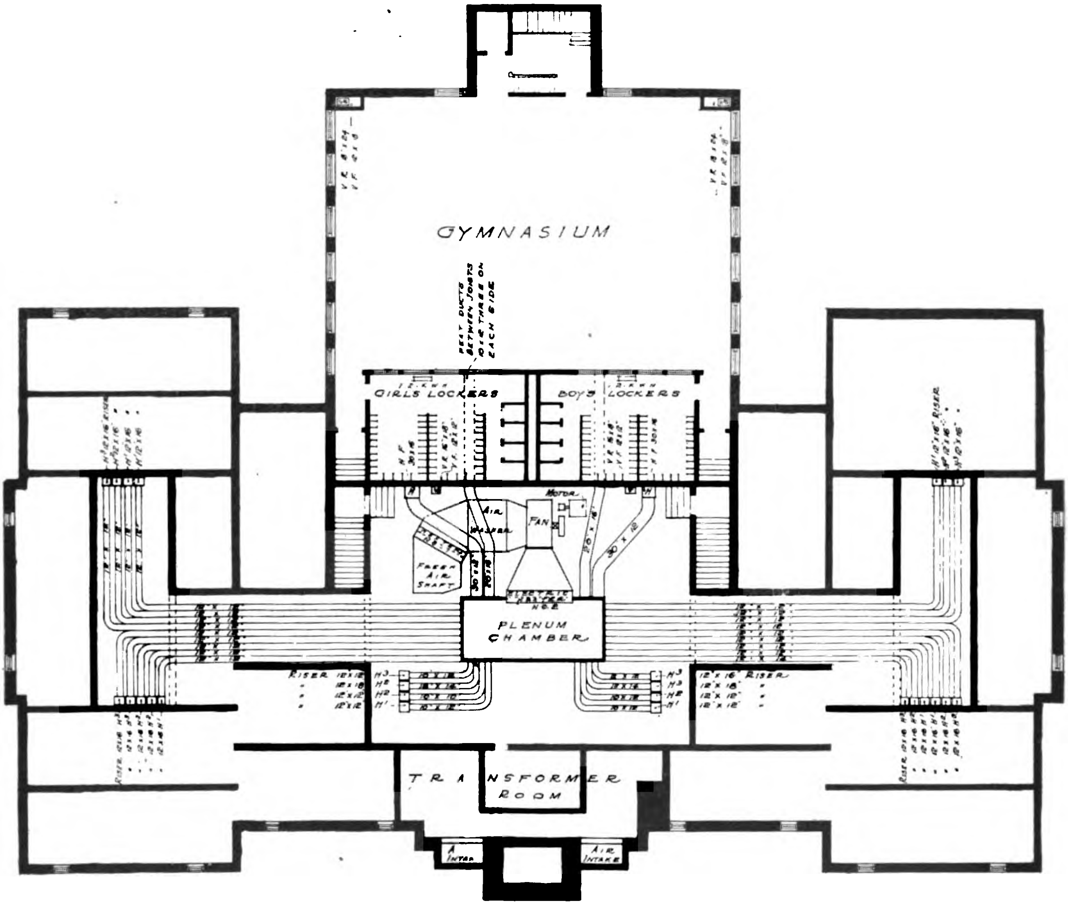
Burley building, however, encloses about twice as much cubical space, necessitating a considerable modification of the layout. At the present writing (December 1, 1915) the Burley plant appears to be a success in every way.

The Minidoka Dam, where the energy for the building is generated, is 22 miles from Burley, on the Snake River. The government contract is with the city of Burley and the school has a contract with the city. According to this contract, electricity is furnished at a cost of $1.00 per kilowatt per month, corresponding to the cost at the Rupert school. This, it is stated, is probably the cheapest rate for electricity on record at the present time.

The energy is carried from the dam to the city on high tension, 33,000-volt, three-phase transmission lines. It enters the building underground by three-phase, 2/0 steel-taped feeders, 2200 volts. In the transformer room the voltage is reducted to 440 volts for heating at full capacity and to 220 volts for times when not so much heat is being used and when the fan is not in motion.

This is accomplished by three 200 K.V.A., type H, 2200-volt primary, 440-220-volt secondary, 60-cycle transformers of the General Electric Company's make. These are located in the concrete transformer room, in the front portion of the basement heating room. They are controlled from the superintendent's office by an automatic no-voltage and overload release switch, three-phase.

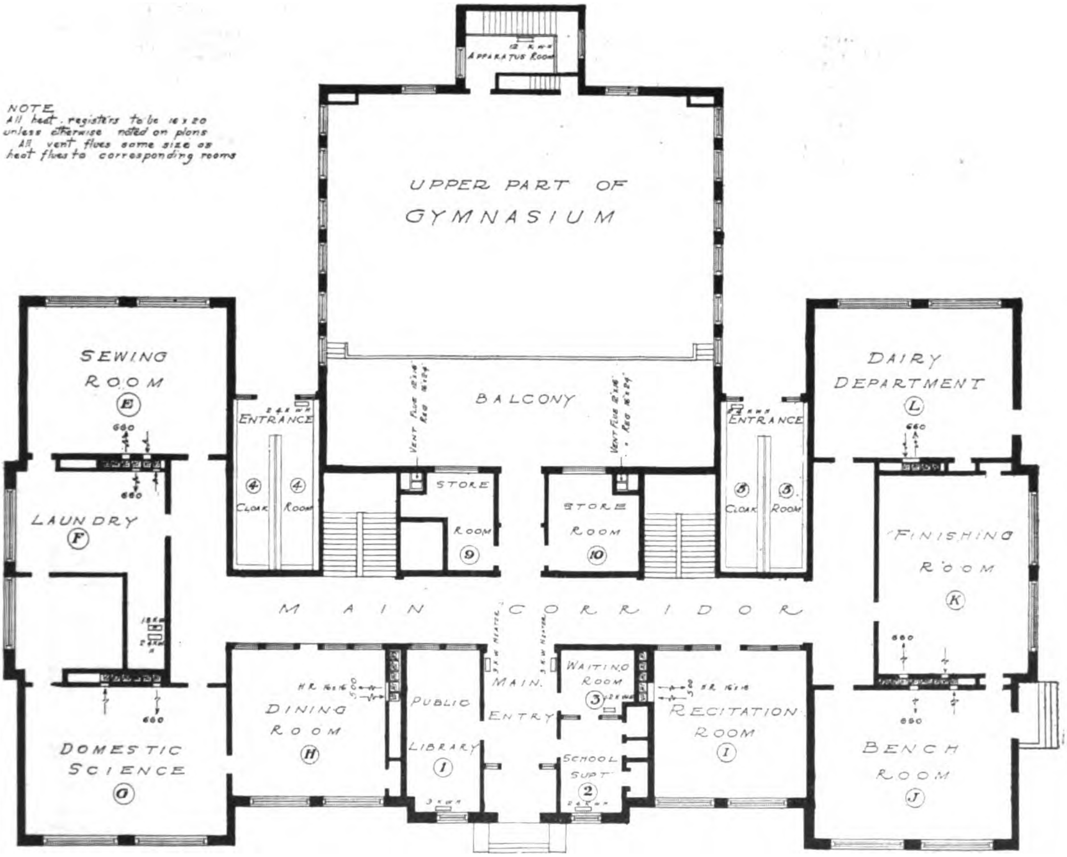
From the transformer room the energy is conveyed to the switch board by three 500,000 c.m. three-phase, steel-taped cables and here distributed to the different relays which feed the heating grids.



BASEMENT PLAN, BURLEY HIGH SCHOOL.

ARRANGEMENT OF HEATING GRIDS.

The grids are arranged in two batteries, the first battery being at the foot of the air shaft which supplies air from the roof level. This set heats the air to 60° F., before it strikes the air washer and humidifier. An automatic temperature control keeps the air at this temperature by throwing the grids on and off as changes in the outside temperature require. This makes the supply of heat absolutely automatic and no more energy is used than that necessary to supply the desired heat.



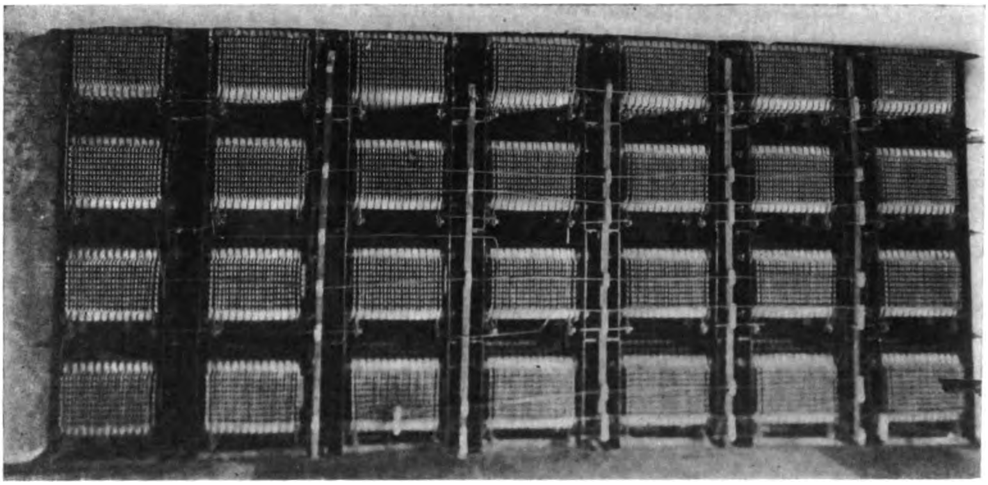
FIRST FLOOR PLAN, BURLEY HIGH SCHOOL.

The water in the air washer is circulated by a motor and centrifugal pump. The spray plays over three sets of louvres. Beyond the washer is located the fan and beyond that is the plenum chamber which is divided into an upper and lower compartment. At the fan side of the upper compartment is the second battery of grids. The air in this compartment is kept at the desired temperature by an automatic control which throws the energy on and off the grids, as the temperature requires.

HOW THE HEAT IS CONTROLLED IN EACH ROOM.

The heat is controlled in each room by thermostats operating dampers at the plenum chamber openings. Air is taken from the lower compartment of the plenum chamber, when the room is too warm, and from the upper chamber, when the opposite condition prevails. The system of control was installed by the Johnson Service Company.

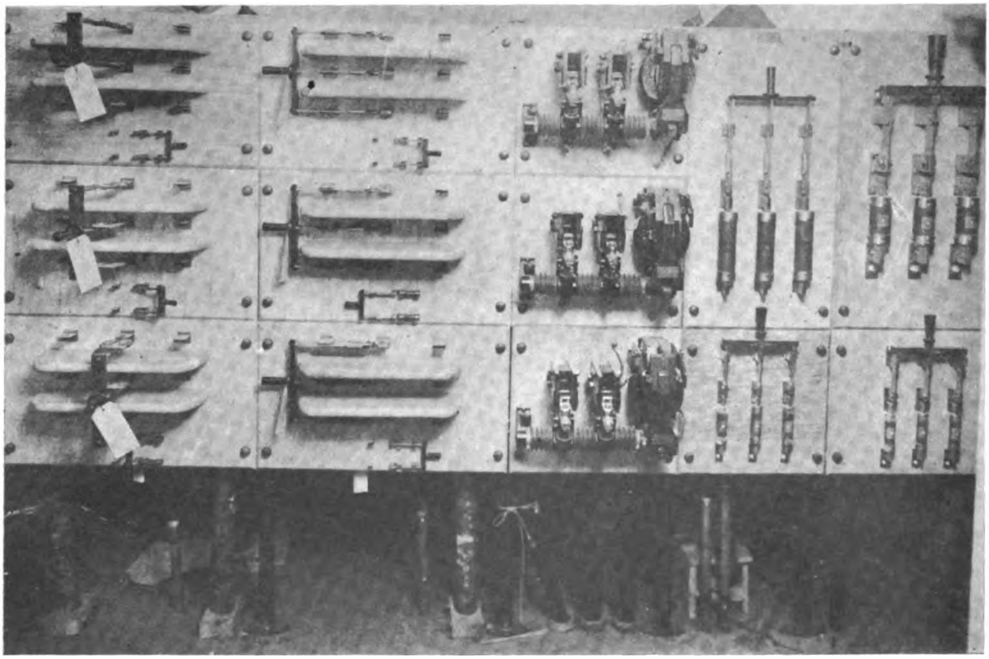
Air is supplied to the building from the roof level and through the operation of the equipment mentioned, is washed and humidified and sent into the rooms at a temperature which is controlled automatically. An overheated room is not cooled by introducing more cold air and thus



BATTERY OF ELECTRIC HEATING GRIDS IN PLENUM CHAMBER, BURLEY HIGH SCHOOL.

dissipating the over-supply of heat, but the energy is cut off before the over-supply is produced.

At the present writing the system is proving very satisfactory and the amount of energy being used is costing $187 per month. This makes the heating comparatively more expensive than if coal were used, but several factors enter into the problem to alter conclusions as to total cost. The first is the matter of space. The electric heating plant occupies a comparatively small space in the basement. Another form of heating would require an extra building and smoke stack.



SECTION OF SWITCHBOARD FOR ELECTRIC HEATING PLANT IN BURLEY HIGH SCHOOL.

The life of the equipment here used will be five to eight times the life of a steam plant. Again, the labor required to operate this plant is almost negligible and this makes a large saving. The absence of coal in the building is, of course, an especially desirable feature of the plant. The smoke from the coal plant is something that can well be missed. Still another point is that the heat is always ready. During the four years that the Government has been generating electrical energy at the Minidoka Dam, the service has not been cut off fifteen minutes at a time.

The Utah Engineering and Machinery Co., Salt Lake City, was the successful bidder on this work and the design was furnished by the company's chief engineer, N. L. Alison, with the assistance of H. T. Plumb, district engineer for the General Electric Co. F. E. Ware, city electrician of Burley, designed the transformer installation and all equipment pertaining to the primary side.

Some Elements of Smokeless Furnace Design

By Osborn Monnett. *

Presented at the November, 1915, *meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers.*

It is the purpose of this paper to call attention to the characteristics of a few conventional settings which have been used in the past, and to point out ways in which they may be improved from a smoke standpoint for territories using high volatile, long flaming coal.

HIGH PRESSURE POWER BOILERS.

With the many types and shapes of boilers on the market today boiler practice gives opportunity for innumerable combinations of stokers and furnaces. The type selected, either of boiler or furnace, does not have as much bearing on the smoke performance as does the manner in which the combination is put together. It is sometimes quite a problem to get a boiler and furance connected in such a manner that both will have a chance to give the best results.

Chain Grate.—Plate 1, Fig. A shows in outline an old type chain-grate setting with a 3½-ft. ignition arch, the stoker being set under the boiler with a clearance of 6 ft. from floor to front header. This setting is typical of the older practice in chain-grate setting, with low, short, flat arch, poor ignition and low capacity. Such an outfit cannot be considered smokeless when carrying any considerable load. The deadening effect of the bank of tubes is such as to extinguish the flame before combustion has become complete, in the same manner that a wire netting will kill the flame from a gas burner, the result being a great deal of smoke. While this setting gives very short flame travel, it must not be inferred that mere length of flame travel is always enough to insure a satisfactory setting. It has been found that on a long gas pass, unless some positive means are taken to cause a mixture, the gases frequently become stratified and do not mix, in which case the combustion cannot be complete.

In Fig. B, Plate 1, the boiler has been raised to 10 ft. under the header; the ignition arch lengthened to 5 ft. and set full extension. This allows more flame travel, but the setting still has some of the defects of the first one and is not good for high capacities. One of the principal defects is that the flow of rich volatile matter may pass into the bank of tubes in an uninterrupted current in the front part of the furnace, while most of the oxygen necessary to burn this volatile matter is passing in at the back part. There is a lack of mixture and consequently incomplete combustion and low economy.

Fig. C, Plate 1, corrects the above defects by using a longer arch, setting the stoker farther under the boiler, decreasing the floor space occupied and narrow-

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*Mechanical Engineer, American Radiator Co.; formerly chief smoke inspector of Chicago.

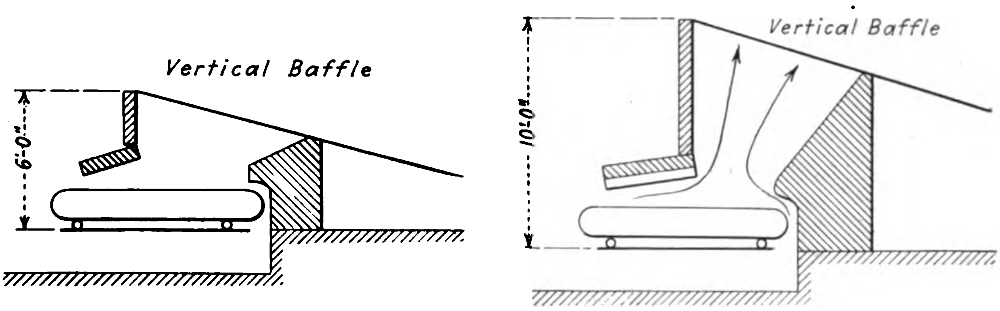


FIG.A Poor

FIG.B Poor

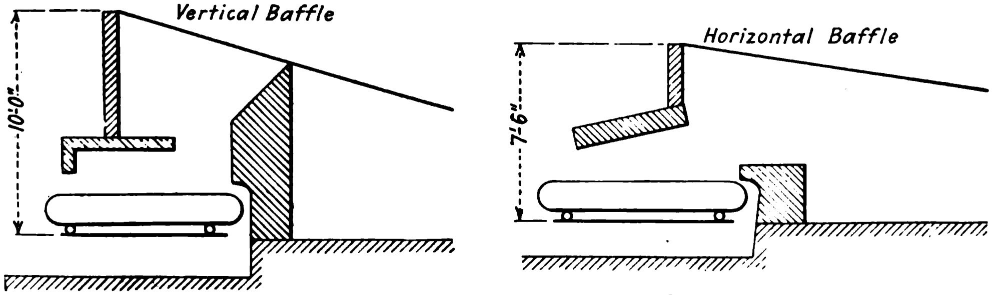


FIG.C Good

FIG. D Good

PLATE 1—SOME CHARACTERISTICS OF CHAIN GRATE SETTINGS.

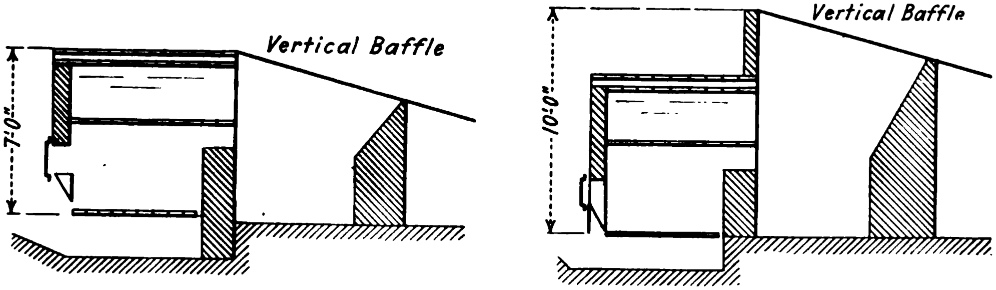


FIG.A Poor

FIG. B Better

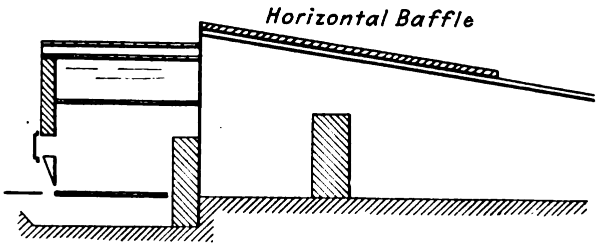


FIG.C Best

PLATE 2—DOUBLE-INCLINED STOKERS AND HORIZONTAL WATER-TUBE BOILERS.

ing up the furnace throat opening so that the volatile gases and air mix in a high temperature zone, which easily completes combustion on a 10 ft. setting. Experiments have been made to determine the best throat opening for commercial use. Openings from 18 in. to 36 in. have been tried with success, the smaller ones being high in maintenance; 30 in. is about the most satisfactory opening for all around use.

Another factor, which has had a marked effect on the performance of the later chain-grate settings, has been the height of the ignition arch at the gate; where 11 in. was formerly the standard height for a flat arch, it has now been increased to 15 in., and the slope of the arch has been increased to 2 in. or 3 in. per ft. Where the arch is sprung across the furnace, it is now set level, 9 in. above the grate at the skewback, with a 9-in. spring, making 18 in. in the center of the arch.

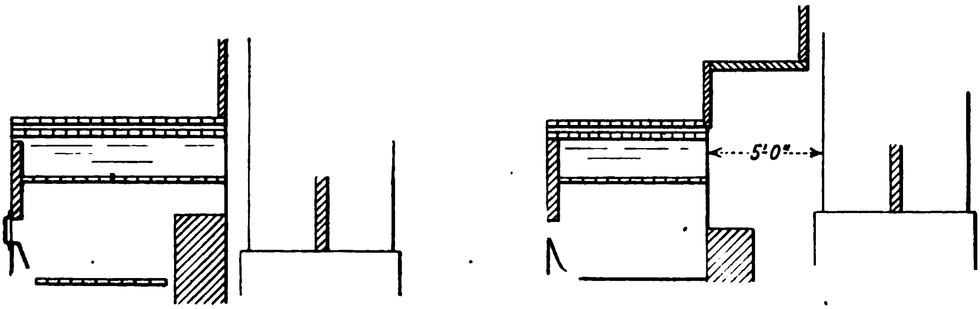


FIG. A Poor FIG. B Good

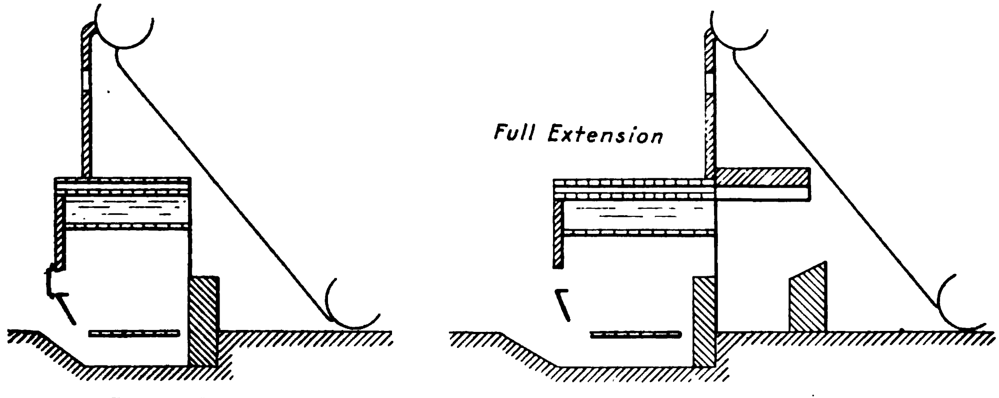


FIG. C Poor FIG. D Good

PLATE 3—DOUBLE-INCLINED STOKERS AND VERTICAL BOILERS.

For the horizontal baffle little need be said from the smoke standpoint as this combination is always satisfactory. Fig. D, Plate 1, shows a setting with 7 ft. 6 in. head room, which can be considered ideal for a chain grate. This dimension may vary considerably without affecting the performance. 6 ft. 6 in. may be considered the minimum head room allowable.

It sometimes happens that, with a tile-roof furnace and a low setting, the furnace gets so hot as to have a bad effect on the life of the brick work. This can be offset in many instances by baring the lower row of tubes, using T tile instead of box tile. This allows more rapid heat absorption into the boiler, increasing the life of the brick work and resulting in a better operating furnace.

Double Inclined Stokers.—For the double inclined type of stoker the short length of flame, discharging directly into the bank of tubes, is undesirable when the fire is being worked. This type of setting is frequently found installed in a 7-ft. head room, as in Fig. A, Plate 2. The human element enters strongly into the matter with such a setting, owing to the possibility of having considerable volatile matter pass off rapidly through carelessness. With a case of this kind it is better to set the boiler with a clearance of 10 ft. as in B, giving more opportunity for the gases to complete their combustion. One of the safest arrangements is to provide a tile-roof setting with an auxiliary bridge wall, Plate 2, Fig. C, breaking up the current of gases and insuring the mixture of any excess amount of volatile matter which may pass off for any cause whatever. The importance of setting this type of furnace with maximum flame travel is not always realized.

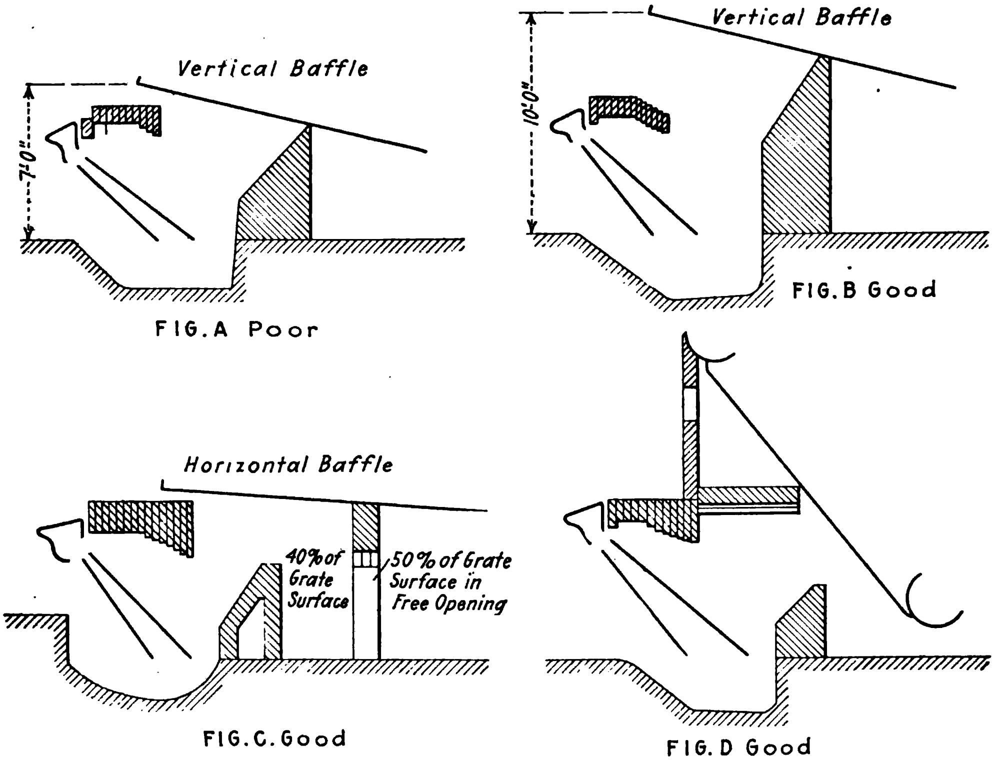


FIG. A Poor

FIG. B Good

FIG. C. Good

FIG. D Good

PLATE 4—COMBINATIONS OF FRONT-FEED STOKERS.

In Plate 3, two different types of boilers are shown with good and bad combustion of double inclined furnaces. It is a safe rule to get a full extension on this type of furnace and never resort to the flush front setting. In the case of Fig. A, Plate 3, the defect of short flame travel is corrected by providing a 5-ft. dog-house extension between the boiler and furnace and by raising the boiler to get the full benefit of the heating surface as shown in Fig. B. Typical Stirling settings are shown in C and D with flush front and full extension furnaces.

Front-Feed Stokers.—With the front-feed stoker the same practice should be observed as regards flame travel. A clearance of 7 ft. is not sufficient to get good results with this type of stoker and vertically baffled, water-tube boilers. A very much improved furnace can be obtained by using a head room of 10 ft. as in Fig. B, Plate 4, a combination resulting very satisfactorily from every standpoint. This design also gives an opportunity for employing a vertical bridge wall, which is nearly always found to be a desirable feature wherever it can be used, as the radiating surface of the hot brick helps to keep the gases hot as they pass out of the furnace.

With a horizontal baffle it is a simple matter to combine this type of stoker successfully. Sufficient head room only is required to get the stoker under the front header. If this cannot be secured in the head room available, it does not alter the effectiveness of the design to excavate as shown in Fig. C. Sometimes piers, or deflection arches, are used with this setting to break up the current of gases. Where a free opening in such a setting does not go below 50 per cent. of the grate surface of the stoker, such construction is desirable. On a vertical boiler always get the maximum extension possible within reason.

Underfeed Stokers.—Underfeed stokers of different types require different head rooms. See Plate 5. The Jones and American types can give excellent results with a head room of 8 ft. 6 in. for a vertically baffled boiler, Fig. B, and 7 ft. for a horizontally baffled boiler. In the case of the former the effort should be to provide enough flame travel to minimize the danger of unconsumed volatile matter passing into the bank tubes.

In the case of tubular boilers the above named types of stokers can be installed with 42 in. from the dead plate to the shell, Fig. C, and the combination will result in a satisfactory performance. With stokers of the Taylor type, Fig. D, a 10-ft. clearance under the front header makes an ideal combination.

Hand-Fired Settings.—One of the most common types of boiler setting encountered is the ordinary hand-fired, return-tubular setting such as is indicated in Fig. A, Plate 6. In this setting there is no attempt made to accomplish a mixture of the gases after they have passed the bridge wall. The setting, while fairly efficient commercially, is very smoky with high volatile coal, and many attempts have been made to improve it. Fig. B, Plate 6, shows a full-extension, Dutch-oven setting by which it was attempted to improve the plain, hand-firing setting. From a smoke standpoint the Dutch-oven setting is a poor combination. Contrary to stoker practice where the fuel is introduced slowly and in small quantities, there is a considerable quantity of coal thrown on the fire at once. The strong radiation from the brick work above the fire has the effect of distilling the gases so rapidly that puffs of dense smoke will be made after firing in spite of every effort to prevent them. Fig. C, Plate 6, shows how to correct this defect by baring the shell to the direct radiation of the fire. This increases the steaming capacity and provides a high temperature zone back of the bridge wall where the gases must mix positively against the deflection arch, which breaks up the stratification and so promotes combustion.

It is not practical to combine a hand-fired, coal-burning furnace with a vertically baffled, water-tube boiler, but it is a simple matter to arrange such a furnace with a horizontal baffle, carrying out the same idea as in Fig. C. The ordinary hand-fired, horizontally-baffled, water-tube boiler furnace is covered with box tile and has nearly all the defects of the Dutch-oven shown in Fig. B, as it is practically a fire-brick enclosed furnace from which the volatile gases will be distilled at a very rapid rate. Fig. D indicates how this can be overcome. The changes indicated are, first, baring the first two rows of tubes over the fire by putting T tile on the second row, thereby avoiding the radiating effect of a mass of fire brick; second, installing a two-span deflection arch to break up the current of gases, as in the case of the return tubular boiler. In both of these furnaces a few simple proportions should be carried out to insure satisfactory results. There should be from 20 to 25 per cent. of the grate surface in free opening above the bridge wall. The free opening from the back of the bridge wall to the deflection arch should not be less than 40 per cent. of the grate surface, while the free opening under the deflection arch should be 50 per cent. of the grate surface. Hand-fired furnaces for high pressure work should be fitted with four air-syphon steam jets, spaced across the furnace above the fire doors, to be used when necessary.

LOW PRESSURE HEATING PLANTS.

The foregoing discussion has been with reference to high pressure power work. The low pressure heating plant presents a problem that in some respects is more

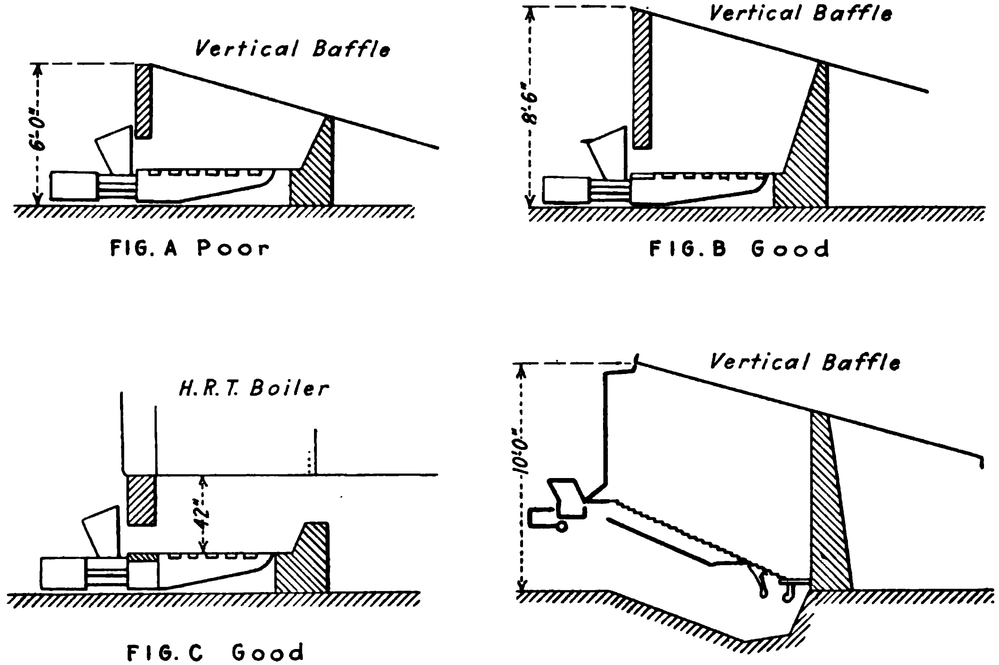


FIG. A Poor

FIG. B Good

FIG. C Good

FIG. D Good

PLATE 5—HEAD ROOMS FOR UNDER-FEED STOKERS.

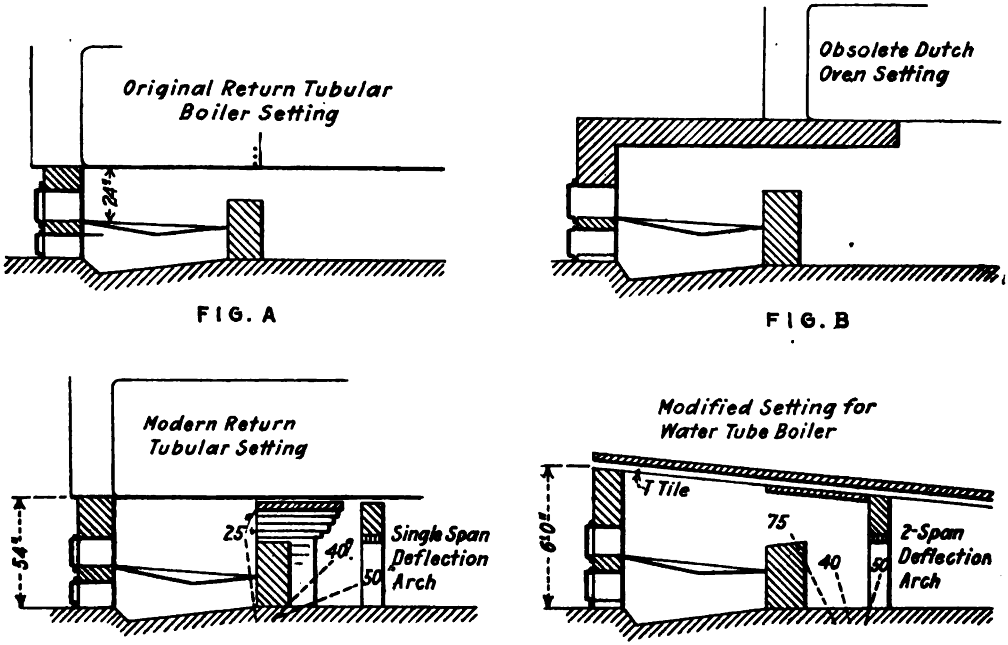

Original Return Tubular Boiler Setting
24"
Obsolete Dutch Oven Setting
Modern Return Tubular Setting
54"
25
40
50
Single Span Deflection Arch
Modified Setting for Water Tube Boiler
T Tile
6'-0"
75
40
50
2-Span Deflection Arch

FIG. A

FIG. B

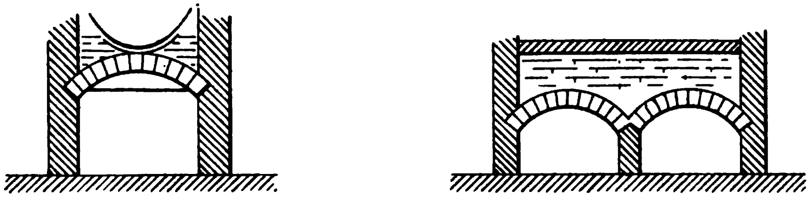
FIG. C % of Grate Surface

FIG. D % of Grate Surface

PLATE 6—DEVELOPMENT OF HAND-FIRED FURNACE.

difficult than any encountered in high pressure work. The plants are not ordinarily large enough to justify stokers, and, even if such was the case, the character of the attendance is not such as would do justice to the equipment. The temperatures are lower and no steam is available for steam jets or for power to drive apparatus. With such conditions as these to meet it has been found that the down draft principle works out very well.

A little study will show why this is so.



Details of Single and Double Span Deflection Arches

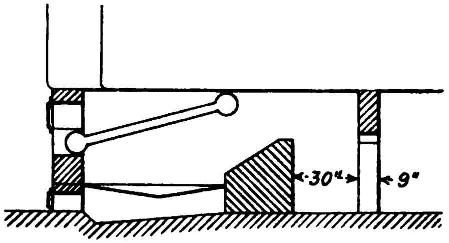


FIG. A Return Tubular

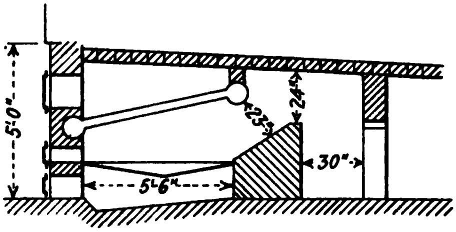


FIG. B Water Tube

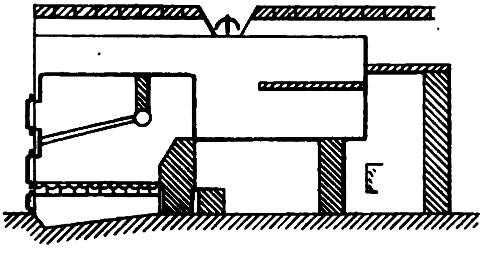


FIG. C Fire Box

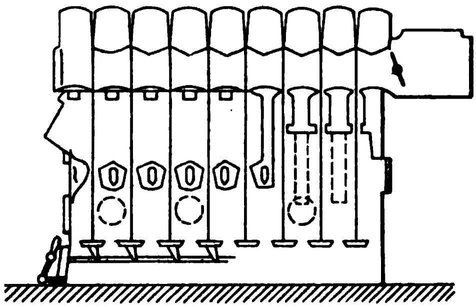


FIG. D Cast Iron

PLATE 7—TYPES OF DOWN-DRAFT EQUIPMENT FOR HEATING LOADS.

The danger of making smoke on a down draft furnace comes from getting green coal on the lower grate, so the longer the fire can remain undisturbed the less chance of making smoke. The rate of combustion on heating loads is low, and allows for long periods during which the fires are not disturbed and no smoke is made. During these undisturbed periods there is accumulating on the water grate a thick bed of coked coal, which, when sliced down to the lower grate, does not make smoke because the volatile matter has all been distilled off. After slicing, the fire can be heavily charged with fresh coal, without disturbing the fuel bed and consequently without causing smoke. It is then in shape for another long undisturbed period.

Another advantage of the down draft principle on heating loads comes from the fact that although the rate of combustion may be at times extremely low, yet the water element directly in the fire furnishes a proportionate amount of steam no matter how low the combustion; so the system is more responsive than would be possible with a plain grate boiler.

The down draft principle can be applied to return tubular or water tube boilers in the larger units. In these units it is advisable to spring an arch in the path of the gas as shown in Figs. A and B, Plate 7. As the rate of combustion on these large units at times approximates power conditions, it is desirable to guard against any excessive amount of volatile matter, which might pass over during these periods, by breaking up the current of gases and giving them an opportunity to burn.

For small units there has been developed in the past few years a number of types of self-contained, steel and cast iron boilers embodying the down draft principle. In the former type the water element consists of water tubes or pipes extended into headers in the ordinary manner and located in the fire box of a locomotive-type boiler. In the cast-iron, down draft type the water element is cast integrally with each section, forming the upper grate, the shape of the elements being such as to facilitate the slicing of coked coal down to the lower grate without disturbing the main body of fuel before the volatile matter has been distilled from it. This type is made in sizes up to 10,000 sq. ft. of radiation in one unit, and can be installed several in a battery.

In conclusion I wish to call attention to the necessity of being in possession of all the facts before attempting to work out any given smoke problem. There are so many variables such as head room, floor space, character of attendants, fuel, etc., to be taken into consideration that each job requires careful study before any recommendation can be made. When proper attention is given to the matter there is no question but what an installation can be obtained which will meet the local conditions.

Determination of Radiator Sizes for Hot Water Heating Plants

BASED ON A RULE APPLYING TO ALL WATER AND ROOM TEMPERATURES.

By FREYWID WEGELIUS.

In THE HEATING AND VENTILATING MAGAZINE for March and August, 1915, Charles A. Fuller and Charles D. Allan have treated in a very meritorious and instructive manner, the important subject of the rate of transmission of heat from radiating surfaces under different temperatures.

Some time ago the writer published, in Helsingfors, Finland, a treatise on this subject, developing a method for figuring radiator transmission, which will be found to be both time and labor-saving. With this method very reliable charts may be used by the practical engineer in calculating hot water radiators. The present article will discuss the theory while a subsequent article will take up the practical application and will be accompanied by the graphic charts mentioned.

After years of experiments, made with the greatest care by several men, prominent in the profession. it has been established that the quantity of heat emitted from a steam radiator is unequal to the heat emitted from a radiator filled with water at the same temperature as the steam and in other respects working under the same conditions as the steam radiator. Thus the coefficient of heat transmission, expressed in B.T.U. per hour per square foot per degree of temperature difference between the heating medium and the surrounding air, is considerably higher for steam than for hot water. In the following the calculation of hot water radiators only is considered.

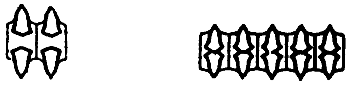


FIG. 1.—CROSS SECTIONS OF ONE AND TWO-COLUMN RADIATORS USED IN TESTS.

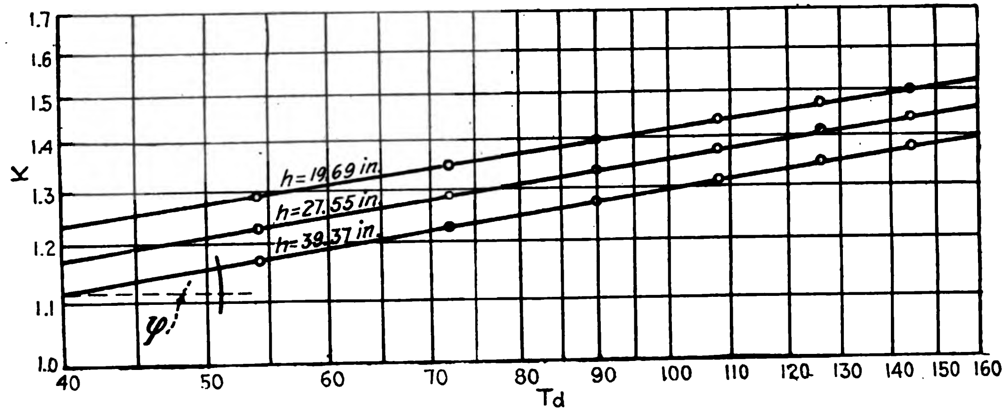


FIG. 2. HEAT TRANSMISSION COEFFICIENTS OF SINGLE AND DOUBLE COLUMN RADIATORS, FOR VARIOUS TEMPERATURE DIFFERENCES.

RULE FOR CALCULATING HOT WATER RADIATION.

The required surface of a hot water radiator may be calculated from the equation:

$$R = \frac{M}{K\,T_d}$$

In this equation

R = the required surface in square feet

M = the B.T.U. transmitted by the total radiator surface per hour

K = the co-efficient of heat transmission expressed in B.T.U. per hour per square foot per one degree of average temperature difference between the heated water and the surrounding air

T_d = the average temperature difference between the heated water and the surrounding air.

This latter equals

$$\frac{T_i + T_o}{2} - T'$$

T_i and T_o being inlet and outlet water temperatures and T' being the temperature of the surrounding air.

HEAT TRANSMISSION COEFFICIENTS AS DETERMINED BY TESTS.

The heat transmission coefficient values are given in the following table and the values may be accepted as reliable, due to the extreme care exercised in the experiments.

The radiator height is measured from center to center.

The fact that the transmission coefficients for 1 and 2-col. radiators of the same height are equal may be explained by the circumstance that there is hardly any difference in the cross sections of these radiators (see Fig. 1).

To get the corresponding values of K for all varying values of T_d and the different radiator heights, within practical working limits, the values of K for 1 and 2-col. radiators are first plotted on logarithmic paper, as shown herewith, the vertical scale indicating the values of K

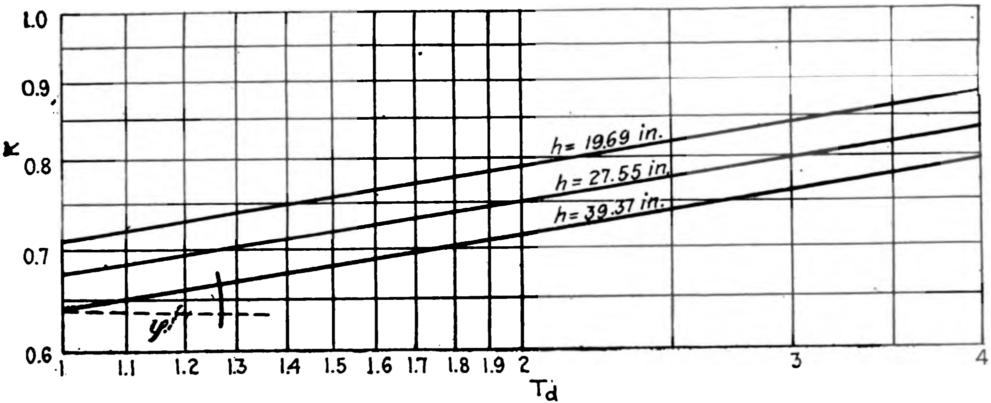


FIG. 3. DIFFERENT VALUES OF ALPHA FOR THREE RADIATOR HEIGHTS.

VALUES OF TRANSMISSION COEFFICIENT K.

Kind of radiator.	Temperature difference, Deg. F.					
	54	72	90	108	126	144
1 and 2-col., 19.69 in. high						
1 and 2-col., 19.69 in. high	1.29	1.35	1.39	1.43	1.48	1.50
1 and 2-col., 27.55 in. high	1.23	1.29	1.33	1.37	1.41	1.43
1 and 2-col., 39.37 in. high	1.17	1.23	1.27	1.31	1.35	1.37
3-col., 19.69 in. high	1.15	1.21	1.27	1.31	1.33	1.35
3-col., 27.55 in. high	1.11	1.17	1.21	1.25	1.27	1.29
3-col., 39.37 in. high	1.07	1.13	1.17	1.21	1.23	1.25

and the horizontal scale the values of T_d. The points indicated are found to be in a straight line, the equation of which takes the form:

$$\log K = \log \alpha + tg\,\varphi \times \log T_d \text{ or}$$
$$K = \alpha\, T_d^{tg\,\varphi}$$

A height of 19.69 in gives $tg\,\varphi = 0.148$
A height of 27.55 in. gives $tg\,\varphi = 0.151$
A height of 39.37 in. gives $tg\,\varphi = 0.155$

Although this table shows that tg φ changes somewhat with the radiator height. the change is so slight that we may consider tg φ as a constant for the three heights and put it at 0 151

By taking $T_d = 1$, we get

$$\log K = \log \alpha + tg\,\varphi \times \log 1, \text{ or}$$
$$K = \alpha$$

By means of the chart shown in Fig. 3, these three different values are plotted. Substituting in the formula, they give the following values of K:

Height 19.69 in.......$K = 0.709\, T_d^{0.151}$
Height 27.55 in.......$K = 0.676\, T_d^{0.151}$
Height 39.37 in.......$K = 0.654\, T_d^{0.151}$

To get the values of K for all other radiator heights, the diagrams shown in Figs. 4 and 5 are made, the vertical scale indicating radiator heights, and the horizontal scale, the values of α as above. The straight line connecting the points plotted is again represented by the equation:

$$\log \alpha = \log \beta + tg\,\varphi \times \log h \text{ or}$$
$$\alpha = \beta h^{tg\,\varphi}$$

h bring the center to center height of the radiator and $Tg\,\varphi = -0.13$

If $h = i$ $\log \alpha = \log \beta + tg\,\varphi \times \log 1$, and

$$\alpha = \beta$$

From fig 5 the value of β is obtained and hence is

$$\alpha = 1.043\, h^{-0.13} \text{ or}$$
$$\alpha = 1.043\, h \frac{1}{h^{0.13}}$$

If this value is substituted for α, the equations above for 1 and 2-col. radiators take the general form:

$$K = 1.043 \frac{T_d^{0.151}}{h^{0.13}}$$

In a similar manner, the values of K are obtained for 3 and 4-col. radiators, α for 4-col. radiators having been assumed proportional to its value for 1, 2 and 3-col. radiators:

1 and 2-col., 19.69 in. high...$0.709\, T_d^{0.151}$
1 and 2-col., 27.55 in. high...$0.676\, T_d^{0.151}$
1 and 2-col., 39.37 in. high...$0.645\, T_d^{0.151}$
3-col., 19.69 in. high.......$0.639\, T_d^{0.151}$
3-col., 27.55 in. high.......$0.613\, T_d^{0.151}$
3-col., 39.37 in. high.......$0.592\, T_d^{0.151}$

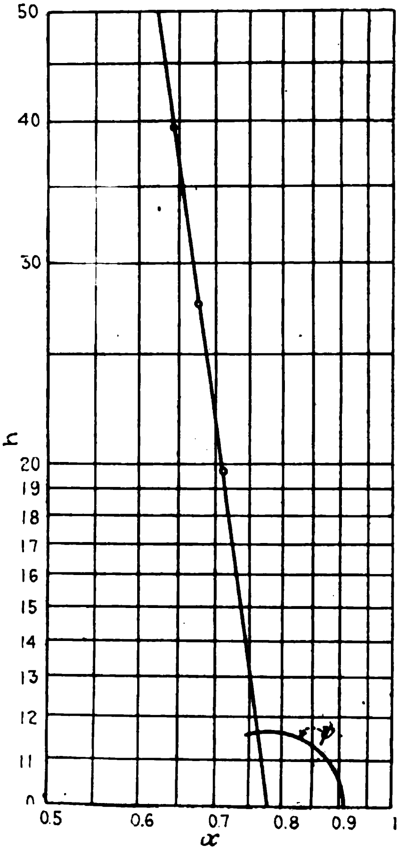


FIG. 4.

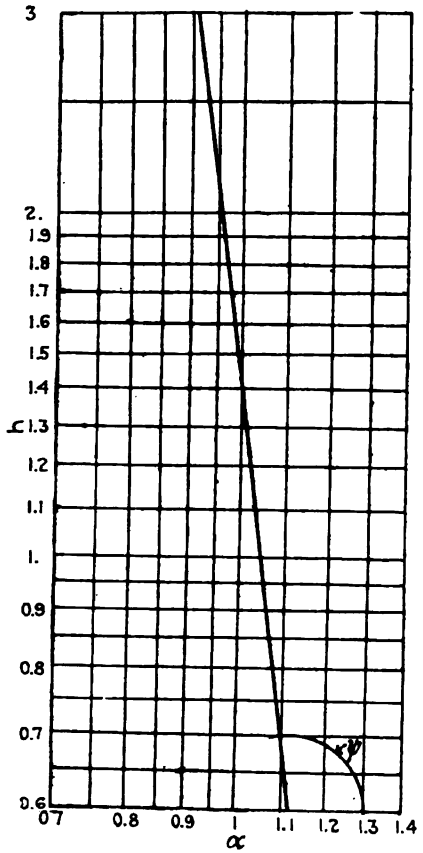


FIG. 5.

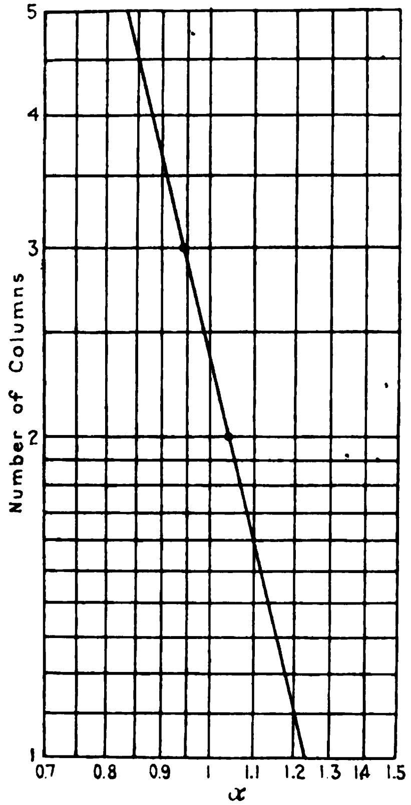


FIG. 6.

GENERAL EXPRESSION OF

	K	R	M
1 and 2 column radiators	$1\ 043\,\frac{T_d^{0.151}}{h^{0.13}}$	$\frac{1}{1043}\,\frac{h^{0.13}M}{T_d^{1.151}}$	$1.043\,\frac{T_d^{1.151}R}{h^{0.13}}$
3 column radiators	$0.944\,\frac{T_d^{0.151}}{h^{0.13}}$	$\frac{1}{0.944}\,\frac{h^{0.13}M}{T_d^{1.151}}$	$0.944\,\frac{T_d^{1.151}R}{h^{0.13}}$
4 column radiators	$0.882\,\frac{T_d^{0.151}}{h^{0.13}}$	$\frac{\ }{0.882}\,\frac{h^{0.13}M}{T_d^{1.151}}$	$0.882\,\frac{T_d^{1.151}R}{h^{0.13}}$

In a subsequent article the writer will show how to determine surfaces, lengths, number of sections, etc., of hot water radiators, without any need of calculations, by using simple charts based upon the foregoing considerations.

The Heat Insulating Properties of Commercial Steam Pipe Coverings

By L. M. McMillan.

(From a paper presented at the recent annual meeting of the American Society of Mechanical Engineers.)

An enormous amount of effort has been extended in attempts to determine accurately the savings effected by the use of non-conducting coverings on steam pipes. But even with the results of all these investigations available, little reliable information is on hand regarding the efficiencies of pipe coverings in commercial use at the present time.

In general, the results of previous tests of heat insulating materials apply at only one temperature, or at most two, and for one or two thicknesses and are not sufficient to determine the laws which govern the flow of heat at different temperatures and for different thicknesses. Therefore, this work fails where an attempt is made to apply the results to modern conditions involving high superheat and thicker coverings.

The work which this paper describes has been carried on for a period of about two years at the University of Wisconsin. The effect on heat losses of varying the temperature difference between pipe surface and air between limits of 0° and 500° F. has been thoroughly investigated. Different thicknesses of material from 0 up to 3 in. were tested and the laws confirmed by the results of these tests permit of their application to any thickness. The drop in temperature from steam in a pipe to the inner and outer surfaces of the pipe wall under various conditions has been accurately determined. Another new fact brought out was that the loss from any covered pipe is a function of the temperature difference between the surface of the covering and the surrounding air; and this function is the same for all coverings having the same character of surface regardless

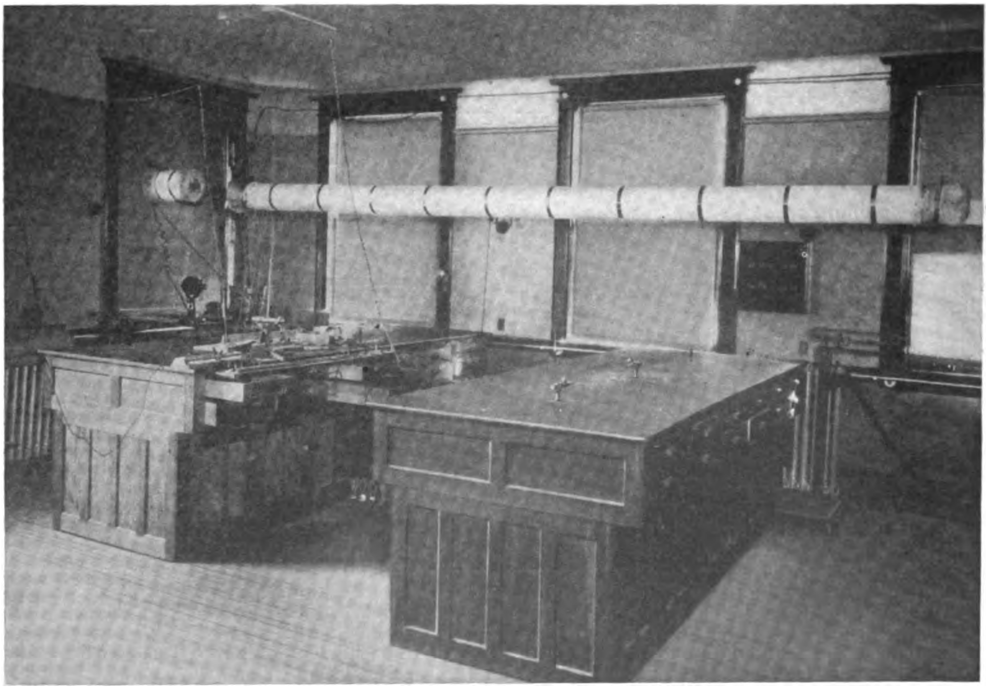
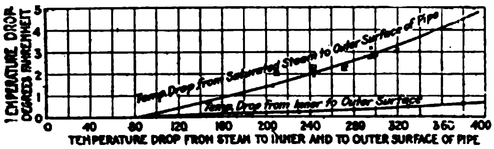
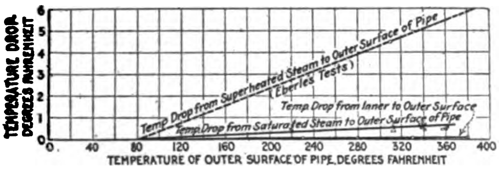


FIG. 1. ARRANGEMENT OF TESTING APPARATUS FOR STEAM PIPE COVERINGS.



Covered Pipe



Uncovered. Pipe

FIG. 2. TEMPERATURE DROP FROM STEAM TO INNER AND OUTER SURFACES OF PIPE.

of what the other properties of the covering may be, since the effects, if any, of these properties appear in the temperature difference. The value of the function has been determined for canvas covered surfaces.

In the tests here discussed, it was proposed to heat a section of covered pipe by means of an electric heater made up of resistance coils immersed in oil inside the pipe, and to calculate the amount of heat lost through the covering by measuring the energy required to hold the outside metal of the pipe at a constant known temperature. Under such conditions it is evident that just enough energy is being supplied to compensate for the losses through the covering; otherwise the excess or deficiency of energy will cause the pipe to heat up or cool off as the case may be. This must be true for, according to the law of conservation of energy, all the energy entering must appear as heat since none is transformed into any other form and none is lost. Fig. 1 is a photograph of the apparatus used for the tests.

(The author brought out the fact that the drop in temperature from the steam to the outside surface of a pipe was probably different than from oil to the same point on account of the different conductivities of these substances.)

The method of test provided for the measuring of the temperature of the outside of the pipe and not of the oil, so that in order to make the results applicable directly to steam conditions it is only necessary to establish a relation between the temperature of steam in a pipe and that of the outer surface of the pipe wall. This difference of temperature has been entirely neglected by most investigators, being accurately measured by none and considered not to exist by most.

Tests made by the author to determine this point showed that the drop in temperature through the wall of a covered pipe containing saturated steam is so small in comparison with the total drop

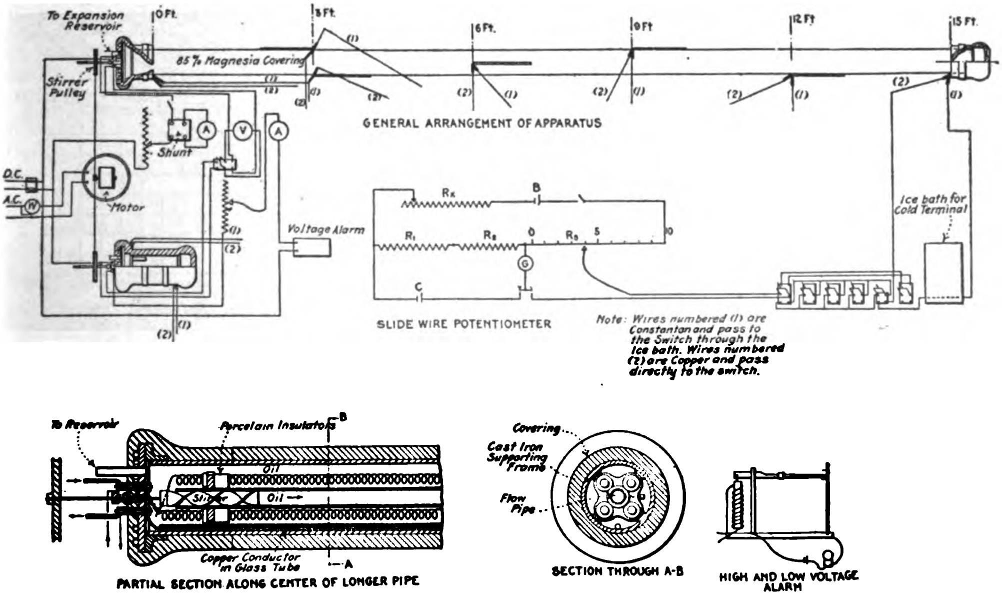

To Expansion Reservoir
0 Ft.
3 Ft.
6 Ft.
9 Ft.
12 Ft.
15 Ft.
85% Magnesia Covering
Stirrer Pulley
(1)
(2)
GENERAL ARRANGEMENT OF APPARATUS
A
V
A
Shunt
D.C.
A.C.
W
Motor
(1)
(2)
Voltage Alarm
Rx
B
R1
R2
0
R3
5
10
G
C
Ice bath for Cold Terminal
SLIDE WIRE POTENTIOMETER
Note: Wires numbered (1) are Constanton and pass to the Switch through the Ice bath. Wires numbered (2) are Copper and pass directly to the switch.
To Reservoir
Porcelain Insulators
B
Oil
Stirrer
Oil
Copper Conductor in Glass Tube
A
PARTIAL SECTION ALONG CENTER OF LONGER PIPE
Covering
Cast Iron Supporting Frame
Flow Pipe
SECTION THROUGH A-B
HIGH AND LOW VOLTAGE ALARM

FIG. 3. APPARATUS FOR OBTAINING HEAT LOSSES THROUGH PIPE COVERINGS.

from steam temperature to room temperature that it may be neglected entirely. However, for superheated steam it should be taken account of, and the steam temperature obtained by adding to pipe temperature the corresponding correction, which may be estimated from Fig. 2.

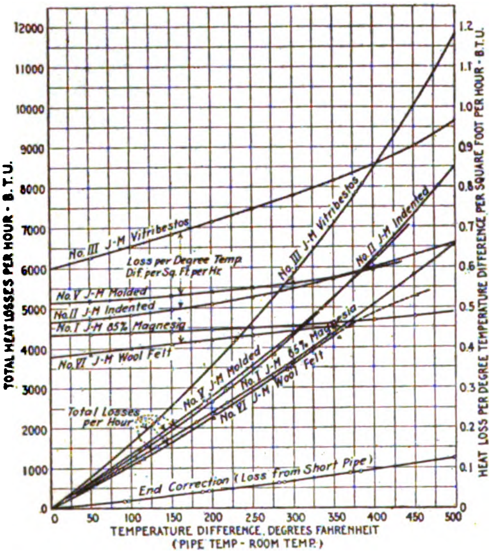


FIG. 4. TESTS OF COVERINGS I, II, III, V AND VI.

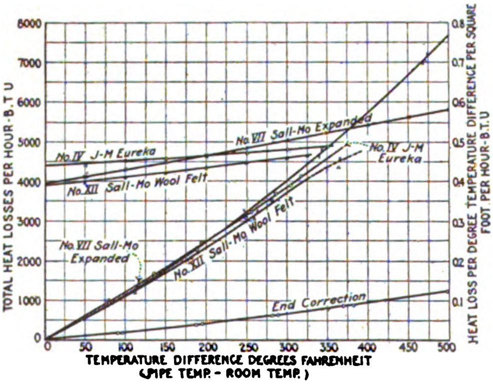


FIG. 5. TESTS OF COVERINGS IV, VII AND XII.

The apparatus used for making the tests was described by the author at length and is shown in the accompanying illustration (Fig. 3). The test pipe is a 16-ft. section of standard 5-in. steel pipe closed at the ends and filled with gas engine cylinder oil. It contains also resistance coils which serve as an electric heater and a stirring device for keeping the oil in circulation. The remainder of the apparatus consists of the electrical instruments for measuring the energy input, a small electric motor for driving the circulating propeller, the thermometers for room temperature, and the thermo-couples and potentiometer for measuring the temperature of the pipe.

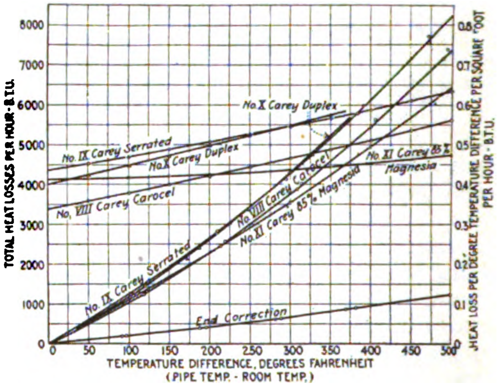


FIG. 6. TESTS OF COVERINGS VII, IX, X AND XI.

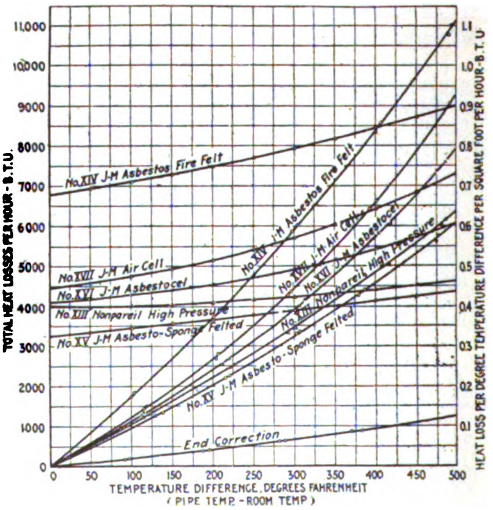


FIG. 7. TESTS OF COVERINGS XIII, XIV, XV, XVI AND XVII.

The coverings, before being tested for their heat insulating qualities, were placed on the steam pipe and allowed to dry for a week. Steam in the pipe was kept at about 130 lbs. pressure throughout that time.

During the tests the room temperature was taken as the average of the readings of five thermometers at different points in the room and all about equidistant from the pipe. These were shielded from direct radiation from the pipe by paper screens placed between them and the pipe so that they registered the correct temperature of the air in the room. All doors and windows of the room were kept closed during the tests.

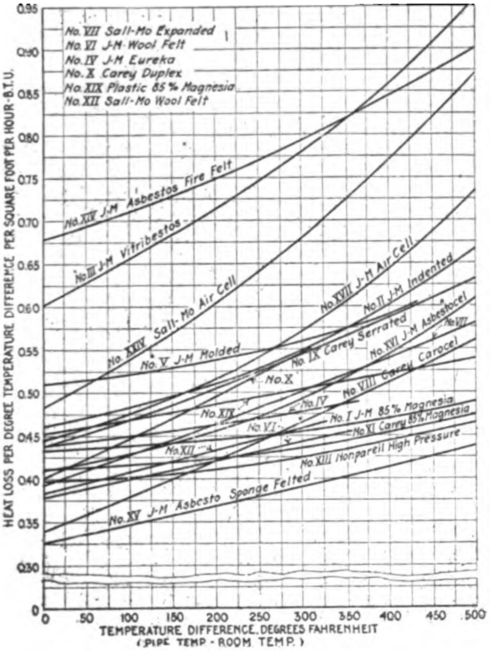


FIG. 8. SUMMARY OF RESULTS ON SINGLE THICKNESS COVERINGS.

THREE IMPORTANT FACTORS IN DETERMINING HEAT TRANSMISSION.

The three factors most important in determining the amount of heat that will be transmitted by a given insulating material are (1) the character of the material, or, in other words, its conductivity; (2) the temperature difference between its two boundaries, and (3) the thickness of the layer of material. The others of lesser importance are the character of the surface and the velocity of the air fanning that surface. These last two were kept constant during all tests. but the effect of varying them with all other conditions constant was not determined. This, however, is contemplated for the near future.

The character of materials was varied while temperature range and thickness were kept constant by making tests of 17 different pipe coverings of approximately the same thickness and subjected to the same temperatures. The effect of the character of the material is shown in Fig. 8.

Tests were made at pipe temperatures ranging from 175° to 575° F. and at least eight or ten tests were made on each material. This was varying the temperature while character of material and thickness remained the same. The effect of temperature on the losses is shown in Figs. 4 to 8. The excellent agreement of many tests is the best indication of the accuracy of the work.

For two different materials the thickness was varied from 0 to 3 ins., while in each case material and temperature range were constant. The effect of thickness is shown in Figs. 9 to 12.

All the coverings tested were bought in the open market and the dealers were given no intimation that the coverings ordered were to be tested.

DISCUSSION OF RESULTS.

The results of the test on bare pipe are shown in Fig. 13. The curve of net heat losses per degree temperature difference per square foot per hour shows that this loss is far from being a constant at all temperatures as has been assumed or implied by most former investigators.

Figs. 4 to 7, inclusive, show curves from tests of 17 different coverings of single thickness, i. e., about 1-in. As will be seen, the radiation and convection from the surface of the covering increases at a more rapid rate than the temperature as the pipe is heated up. But the principal reason for the increase in the rate of losses in the case of covered pipe is within the covering itself. Where the air spaces in the coverings are large, heat is transmitted through them by radiation and convection, in addition to the heat that is conducted by the solid material. This accounts for the greater slope of the rate curves for air cell and similar coverings than for magnesia, diatomaceous earth, etc.

The net heat loss curves from all the tests of coverings 1 in. thick are assembled in the form of a general summary

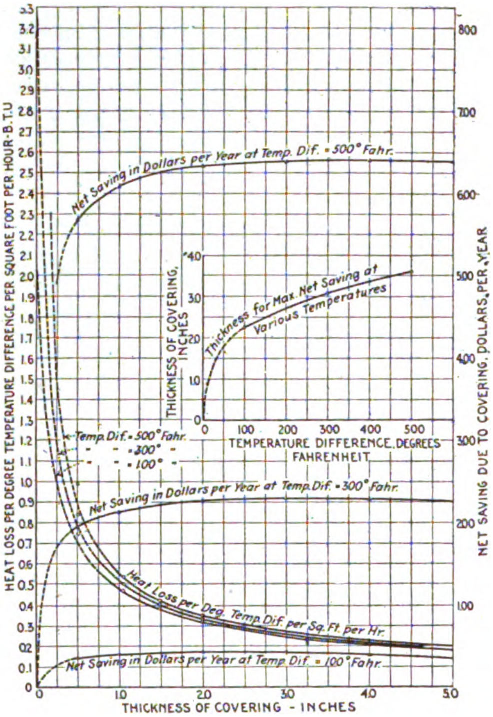


FIG. 9. THICKNESS-SAVINGS CHART FOR 85% MAGNESIA COVERINGS.

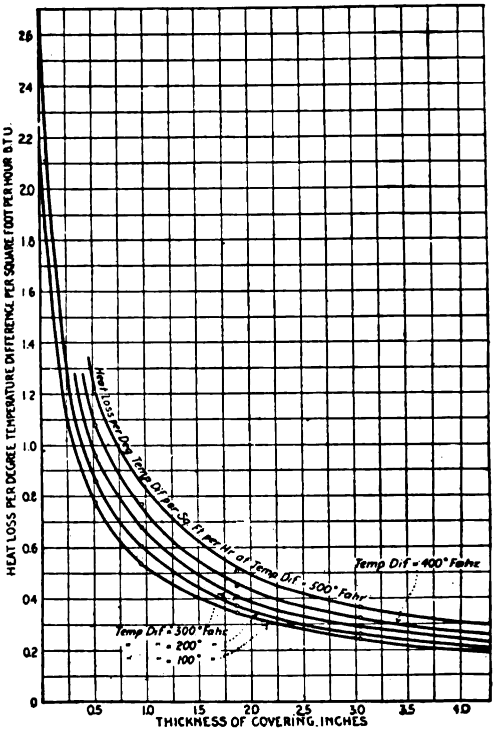


FIG. 11. THICKNESS HEAT LOSS CURVES FOR SMALL-MO CELL COVERINGS.

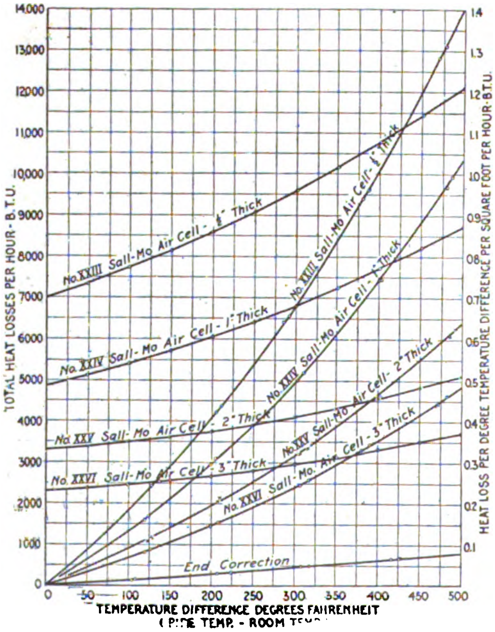
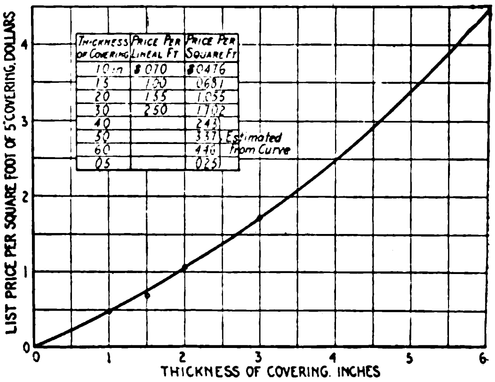


FIG. 10. TESTS OF COVERINGS XXIII TO XXVI.



Thickness of Covering	Price Per Lineal Ft	Price Per Square Ft
1.0 in	$0.70	$0.476
1.5	1.00	0.681
2.0	1.55	1.055
3.0	2.50	1.702
4.0		2.43
5.0		3.37
6.0		4.46
0.5		0.251

FIG. 12. STANDARD LIST PRICE OF 5-IN. PIPE COVERINGS.

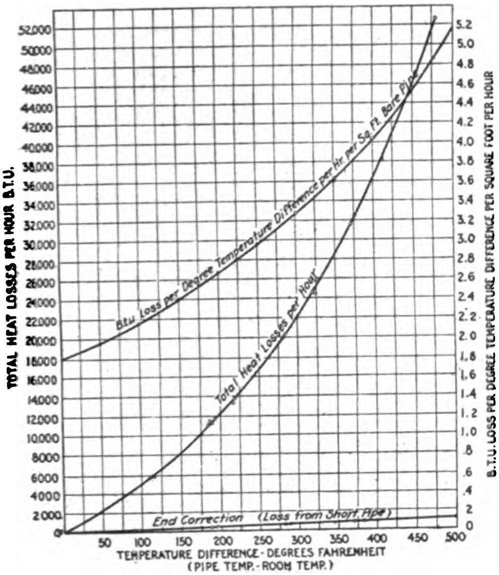


FIG. 13. TEST OF BARE PIPE.

in Fig. 8. From the curves shown in this figure, one can tell at a glance what coverings are the more efficient at any temperature. Of all the coverings tested the four best, at temperatures of 200° to 600° F. are J-M asbestos-sponge felted, Nonpareil high pressure, Carey 85% magnesia and J-M 85% magnesia, ranking in the order named, with the first well ahead of all the others. Those losing the greatest amount of heat were J-M vitrebestos and J-M firefelt. The first of these latter is little used as a pipe covering, being employed mostly for stack linings, etc., while the virtue of the second is in its being a heat-proof material suitable for use as the layer in contact with a pipe carrying superheated steam, where the better insulating material used for the outer layers could not stand the temperature of superheat.

The saving in dollars per year due to use of covering has been calculated for each of the coverings tested and the results were given in a table. Also, the first cost of the covering is taken account of and values of net saving and per cent. saving on investment are given for values of temperature differences of from 1° to 500° F. The saving in B.T.U. per degree temperature difference per square foot per hour was first found for each temperature by subtracting from the bare pipe losses at that temperature the loss from covered pipe at the same temperature. Then the total saving per square foot for a year of 365 24-hr. days was found by multiplying the saving per degree per hour per square foot by 8,760 and by the temperature.

The cost of heat was taken at $0.30 per 1,000,000 B.T.U., which is nearly equivalent to $0.30 per 1,000 lbs. of steam. Using this value, the saving in dollars per square foot per year was computed. The first cost of covering was ascertained from the manufacturers, and 10 per cent. of the list price was added for erecting and 10 per cent. more for painting. The cost of covering per year was taken as 14 per cent. of the total first cost, the 14 per cent. including interest, depreciation, repairs, insurance, etc The difference between the total saving per year and the cost of covering per year is the net saving per year.

The results of tests on ½-in., 1-in., 2-in. and 3-in. thicknesses of plastic 85% magnesia are given in Fig. 14. Fig. 9 shows the variation of losses with thickness at temperature difference of 100°, 300° and 500° F. and for thicknesses from 0 to 4 ins. These curves were plotted from data calculated from a theoretical equation, using constants determined in the tests herein described. The points marked 0 are values from the actual experiments and they fall on the calculated curves with remarkable regu-

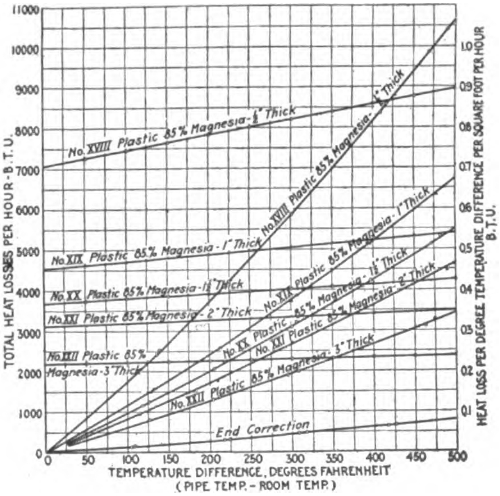


FIG. 14. TESTS OF COVERINGS XVIII TO XXII.

larity except at the ½-in. and 3-in. points.

Figs. 10 and 11 show results of similar tests on different thicknesses of air cell covering. These two coverings, magnesia and air cell, were chosen because of their being representative of the two different classes of materials, i. e., those with very small air spaces and those with rather large air spaces.

The yearly net saving in dollars were calculated for various thicknesses of J-M sectional 85% magnesia at temperature differences of 100°, 300° and 500° F. The variation of standard list prices with thickness is shown in Fig. 12. These values were used in computing the cost per year of the various thicknesses of coverings and results are given in Table 1.

The curves for net savings per square foot per year in Fig. 9 show a rapid increase in savings as the thickness is increased up to a point of maximum savings after which there is a decrease owing to the rapid increase in cost of covering. Fig. 9 shows the proper thickness for the maximum net saving at any temperature difference from 0° to 500° F.

The chart for proper thickness mentioned above applied only to the case where steam costs $0.30 per 1,000 lbs. and is on 365 days in the year. Fig. 15 is a chart for proper thickness of magnesia covering to be used at any temperature, any price of steam and any number of hours service per year. The chart does not show values for length of service, but to use it for other periods than 365 days at 24 hours a day, multiply the price of steam by the number of hours per year the steam line considered is in service and divide by 8,760 and, using the result as the price of steam on the chart, find the proper thickness.

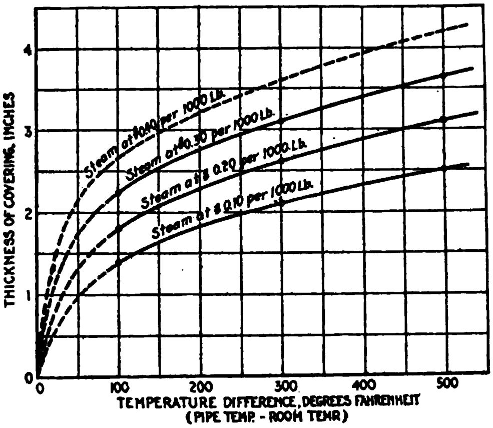


FIG. 15. CHART FOR DETERMINING PROPER THICKNESS OF 85% MAGNESIA FOR MAXIMUM NET SAVINGS AT VARIOUS TEMPERATURES AND PRICES OF STEAM.

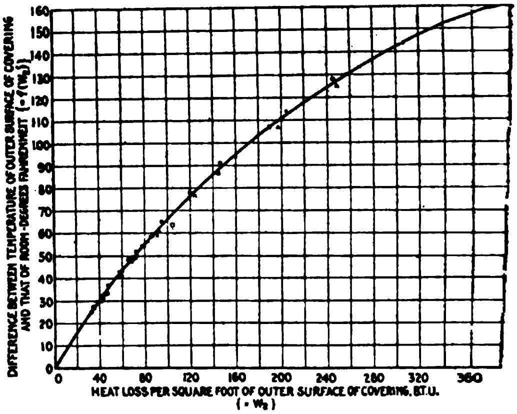


FIG. 16. CURVE SHOWING RELATION OF HEAT LOSSES TO TEMPERATURE DIFFERENCE BETWEEN COVERING SURFACE AND SURROUNDING AIR.

For example, suppose that the steam pressure is 150 lbs. per square inch gauge, that it costs $0.30 per 1,000 lbs. generated, and that the line is in use 12 hours a day and 9 months out of the year. The number of hours per year that the steam is on is therefore 2,920, or 1/3 of the time. The price of steam to be used on the chart is 0.30 (2920/8760) = $0.10. The temperature of the pipe containing steam at 150 lbs. gauge pressure will be about 365° F., and assuming a room temperature of 80° the temperature difference between pipe and room will be 285° F. Now on the chart, using the curve for steam at $0.10 per 1,000 lbs., the proper thickness corresponding to 285° temperature difference is found to be 2.1 in. This, then, is the proper thickness for maximum net saving under the given conditions.

In conclusion it may be said that in most cases it pays to use the best commercial pipe covering obtainable; because where the material is paid for many times over during the first year by the saving effected by its use, the first cost loses much of its weight as a determining factor in the selection of type of covering to be used. In view of the results of the thickness tests, it is a deplorable fact that few steam lines at the present time are provided with thick enough a covering for the greatest net saving. However, where fuel is cheap and the lines are in use only a small percentage of the time, the cheaper coverings have their advantages. Also there are places, as on some heating systems, where the heat lost through the coverings is not wasted and the object of covering the pipes at all is to keep tunnels, etc., cool enough that men may work in them. Therefore, a careful study of conditions is necessary before a certain type of covering can be recommended for a given piece of work. However, it is hoped that the data given in this paper will be of assistance to engineers in deciding upon the material to be used under certain conditions, and in calculating heat losses on installations already in use.

TABLE 1. DATA ON EFFICIENCIES AND SAVINGS OF VARIOUS THICKNESSES OF 85% MAGNESIA COVERING.

Temperature Difference	Thickness	B.t.u./Sq.ft./deg.dif./hr.			Saving	Efficiency	Total Saving/yr.		First Cost of Covering	Cost of Covering/yr.	Net Saving
		Bare Pipe	Plastic 85 per cent Magnesia	Sectional 85 per cent Magnesia			B.t.u	Dollars (Steam at 30c/1000 lb.)			
100	0.5	2 152	0.735	0.691	1.461	67.8	1,280,000	0.384	0 125	0.018	0.366
100	1.0		0.492	0.462	1.690	78.4	1,481,000	0.444	0.238	0.033	0.411
100	2.0		0.319	0.300	1.852	85.5	1,622,000	0.486	0.341	0.048	0 438
100	3.0		0.248	0.233	1.919	89.1	1,681,000	0.504	0.528	0.074	0.430
100	4.0		0.209	0.196	1.956	90.8	1,714,000	0.514	0.851	0 119	0.395
100	5.0		0.185	0.174	1.978	91.9	1,733,000	0.520	1.215	0 170	0.350
300	0.5	3.260	0.805	0.757	2.503	76.8	6,579,000	1.975	0.125	0.018	1.957
300	1.0		0.524	0.493	2.767	84.9	7,270,000	2.181	0.238	0.033	2.148
300	2.0		0.335	0.315	2.945	90.4	7,740,000	2.322	0.341	0.048	2.274
300	3.0		0.260	0.244	3.016	92.5	7,922,000	2.377	0.528	0.074	2.303
300	4.0		0.219	0.206	3.054	93.7	8,026,000	2.408	0.851	0.119	2.289
300	5.0		0.192	0.181	3.079	94.4	8,090,000	2.427	1.215	0.170	2.257
500	0.5	5.180	0.895	0.842	4.338	83.7	19,000,000	5.700	0.125	0.018	5.682
500	1.0		0.557	0.524	0.656	89.9	20,410,000	6.125	0.238	0.033	6.092
500	2.0		0.350	0.329	4.851	93.6	21,260,000	6.380	0.341	0.048	6.332
500	3.0		0.273	0.257	4.928	95.0	21,570,000	6.470	0.528	0.074	6.396
500	4.0		0.229	0.215	4.965	95.8	21,750,000	6.525	0.851	0.119	6.406
500	5.0		0.199	0.187	4.993	96.4	21,880,000	6.560	1.215	0.170	6.300

TABLE 3. CONDUCTIVITIES OF PIPE COVERINGS AT 300 DEGREES TEMPERATURE DIFFERENCE BETWEEN PIPE SURFACE AND ROOM.

No.	Kind of Covering	Conductivity
I	J-M 85 per Cent Magnesia	0.551
II	J-M Indented	0.686
III	J-M Vitribestos	1.087
IV	J-M Eureka	0.549
V	J-M Molded Asbestos	0.778
VI	J-M Wool Felt	0.521
VII	Sall-Mo Expended Asbestos	0.598
VIII	Carey Carocel	0.540
IX	Carey Serrated	0.682
X	Carey Duplex	0.636
XI	Carey 85 Per Cent Magnesia	0.546
XII	Sall-Mo Wool Felt	0.510
XIII	Nonpareil High Pressure	0.543
XIV	J-M Asbestos Fire Felt	1.093
XV	J-M Asbestos Sponge Felted	0.468
XVI	J-M Asbestos Cell	0.596
XVII	J-M Air Cell	0.718
XVIII to XXII	Plastic 85 Per cent Magnesia	0.587
XXIV	Sall-Mo Air Cell	0.802

The durability of materials used for pipe coverings is a very important factor in determining the most economical covering for a given set of conditions. It has already been pointed out that the proper basis for comparing costs was the cost per year and not the first cost of the material. This is true because the covering giving the greatest length of service for a given first cost and efficiency is obviously the one to select. In general, fibrous coverings are more durable than the molded forms; since the latter tend to revert to their original powdered state due to vibration and rough usage.

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WITH "Winter Building" as a slogan, a campaign has been started to encourage building as an all-year-round proposition. The point is made that the dropping off of general building activity during the cold weather is due more to force of habit than to any more substantial cause. In support of this statement opinions have been obtained from architects and manufacturers of building material, indicating that the architects are as anxious for more winter building as the building supply manufacturers. A manufacturer of asbestos sheathing paper and of materials used in the installation of heating plants wrote that "without doubt an increase in winter building would give improved conditions to all material houses," and endorsed the proposal to influence the architects and builders toward a wider activity during the cold season.

Two manufacturers, while personally endorsing the plan, believed the old bugaboo, "there always has been a dull season and there always will be one," and added, "the opinion seems to be that the bulk of small building will be held up during the cold weather, however desirable it may be to extend it." The consensus of opinion, however, was to the effect that any manufacturer entering on such a campaign would benefit the architect and contractor, as well as the owner.

One of the most interesting points, from the standpoint of the heating engineer, is a statement regarding the effect of summer dampness on the interior woodwork of buildings. It was claimed, for instance, that the liability of the woodwork to shrink or swell in the winter time is far less than in summer, when the comparatively high moisture content of the air has the effect of swelling such woodwork, with the result that when the cold weather comes, accompanied by the lack of moisture in artificially heated air, it is a common experience to find such woodwork shrunken, resulting in the appearance of cracks and apertures which seriously affect the heating requirements. It is a fact that the "loosely constructed" building very often figures in the calculations of the heating engineer and it might be profitable to determine whether a house constructed in the winter time is any "tighter" than a similar one built in warm weather.

As one writer points out, the delays incident to the completion of a building in the winter, with its cold weather and storms, are unavoidable and this is a point that would have great weight in certain localities. But there are other sections, and they include portions of the country where the average winter temperature is well above the freezing point, as well as being busy business centers, where more winter building could be carried on to advantage, and in these sections the campaign may easily have important results.

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

CONDUCTED BY IRA N. EVANS, C. E.

56—Points in Forced Hot Water Heating Work.

QUESTION: I should esteem it a favor if you will inform me of the best book dealing with forced circulation hot water heating work. I would like to procure information on such details as (a) sizing and connecting up of cold feed to the apparatus, (b) necessity and positions for open vents, if any, and the height they should be carried above feed tank, (c) position, connections and relation of expansion tank to the apparatus and the feed tank. Such details are, of course, essential, but through the frictional resistances, etc., of the various circuits can be adequately dealt with from the information given in such books as Meier's "Mechanics of Heating and Ventilation," such details as (a), (b) and (c) are lacking. I should also like to obtain some information relative to the theory of the distribution of pressure when the pump is going, etc.

ANSWER: There is no book on this subject, although many devote small sections, stating it is merely a question of hydraulics and the determination of the friction and flow of water for a piping system between the radiators and heaters, pumps, boilers, etc.

The economies possible with the combination of hot water heating with condensing power units, whereby the heating system is utilized as a power plant adjunct to condense exhaust steam under partial vacuum, do not seem to be generally appreciated, or not to the extent of advocating many actual installations. It is possible to install condensing turbines and hot water heating in large plants, especially office buildings and hotels where 800 H.P. or more is required, and accomplish the following results:

RESULTS POSSIBLE WITH CONDENSING TURBINES.

(1) Utilize the exhaust steam without modifying the type of engine so as to reduce its economy in summer under full vacuum.

(2) Obtain the condensing effect of the heating system by taking advantage of the possible low temperatures of the heating medium in moderate weather, with lower cost of operation than with present methods.

(3) Regulate the temperature of the entire system by varying the vacuum from 0 in. to 26 in. or 27 in. to meet the weather changes from 0° to 60° F. outside, with the same efficiency as automatic temperature control on steam heating.

(4) The engine economy will be proportional to an average of 20 in. vacuum for that portion of the power required for the supply of exhaust steam for heating and 26 in. to 27 in. for the balance in winter and the entire power in summer, as against 0 to 5 lbs. back pressure for the entire year for all power where steam is employed.

(5) The water bill for the power, condensing with cooling tower or kindred apparatus, would be 15% less than where the surplus steam is exhausted to atmosphere under atmospheric pressure, due to the reduced steam rate in the engines.

(6) The cost of the combined hot water condensing plant, complete with turbines, cooling towers, etc., can be purchased for about the same cost as vacuum steam with large Corliss compound engines, arranged for non-condensing operation on an economical basis, and the same amount of radiation only is required for both systems.

These statements are all susceptible of proof and the condition applies to any plant with a capacity of 500 H.P. or more, and especially to large office buildings and hotels.

It is not possible, as a rule, to accomplish these results where the heating and power plants are designed independently; if large Corliss engines are installed, the cost is excessive, and, if steam heating is used, condensing operation does not pay.

It has been said that the water pressures in high buildings are dangerous, due to the liability of bursting and damage. At the same time, there are several large buildings 16 to 20 stories high heated by hot water and in successful operation. This is the same kind of argument as was formerly made against boilers with over 100 lbs. of steam some years ago.

There is no argument in the adoption of main with the flow of water, regardless of the grade.

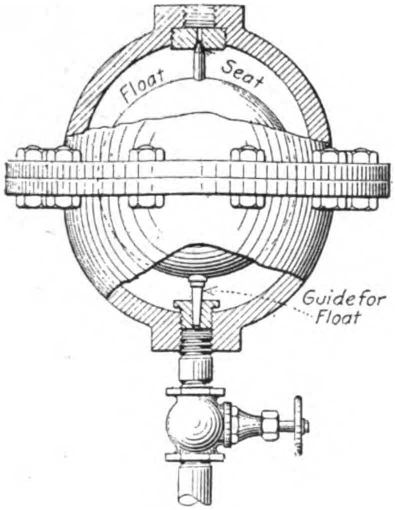


FIG. 1. AIR TRAP FOR USE WITH WATER HEATING SYSTEM.

water over steam on the score of more efficient heating, as the writer believes steam and vacuum systems are now designed that give just as good service from every standpoint of efficiency and economy, as hot water.

ADVANTAGES OF CONDENSING POWER AND HEATING PLANT.

The only reason for advocating this combination is the increased engine economy on the combined hot water heating condensing plant, due to the low terminal exhaust temperatures possible, which are impracticable with steam systems of any type.

The saving in fuel on a 2,000-H.P. installation of the hot water condensing type of power and heating plant is easily $10,000 per annum over the non-condensing steam plant, with an initial cost of the same amount for installation. The radiation on such a system is no greater in amount than for vacuum steam, as the same temperatures are maintained in zero weather, which is about 2% of the time.

It is of course admitted that this arrangement is not adapted to all plants, but at present the engine plant is modified and made more uneconomical permanently so as to utilize exhaust steam, while with the arrangement mentioned the most economical turbines may be used and the power plant is not modified in any respect to adapt the engines to the heating system. It is along the above lines that the author believes the greatest possibilities lie in the use of hot water heating by forced circulation. For many years this system was controlled by patents and for that reason the engineering profession generally opposed its introduction.

FEED WATER CONNECTIONS.

Regarding the specific queries raised by our correspondent, (a) the feed to a hot water system depends on the city pressure and need never be over 1 in. for the largest plant. The water lost from a heating system of this type should be a minimum. If the water in the system is changed to any extent, the contained air in solution in the new water will give trouble from air in the pipes and cause rapid deterioration, due to corrosion.

The cold water connection is generally made through an automatic water feeder to the expansion tank placed at the top of the system, as shown in Fig. 2. This arrangement requires a constant city pressure on the supply somewhat greater than the height of the system, plus the pressure at which the pop safety valve is set, so as to cause water to flow in at all times.

On large plants it is customary to make an auxiliary water connection of 1½-in. to 2-in. pipe for filling quickly by hand. In some cases, especially where the city pressure is light, the boiler feed or house pump is cross-connected with the heating system for this purpose.

(b) Air traps composed of a float and seat, as shown in Fig. 1, are placed on all high points and air pockets of the system. The discharge is connected to a sink or some place where any slight drip will do no damage. A good steam drain trap turned upside down will serve the same purpose, so arranged that when the water raises the float it will close the opening.

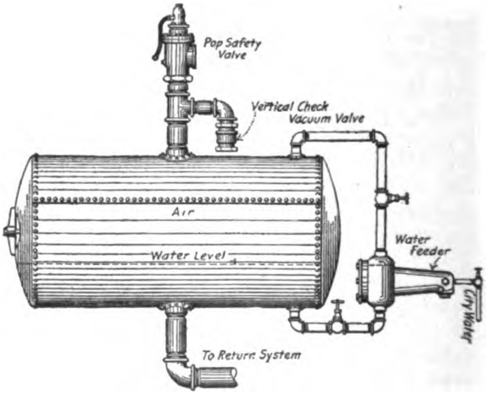


FIG. 2. EXPANSION TANK AND CONNECTIONS AT HIGH POINT.

In the use of a drain trap care must be taken that the type is such that the outlet is not submerged when the float opens, or a slug of water will be discharged each time the trap operates. All mains are graded up in the direction of the flow, never the reverse, as the pump drives the air to the end.

Air lines are not generally used, although there is no objection. They may be carried to the expansion tank but it is difficult and expensive to obtain clear runs from all points that will exhaust the air properly.

The air trap in Fig. 1 makes the best and most economical arrangement. It is presumed by the feed tank is meant the expansion tank.

ARRANGEMENT OF EXPANSION TANK.

(c) There are two general methods for the arrangement of the expansion tank on such a system. The one shown in Fig. 2, placed at the top of the system, and the one placed at the base of the system in the boiler or pump room under the direct charge of the operatives. Fig. 2 shows all necessary equipment as follows:

(1) Pop valve to maintain 5 lbs. to 10 lbs. above the static height of the system and prevent any excessive pressure on the apparatus. This should be a brass nickel seat valve of the very best type, from 2 in. to 3 in. in diameter, dependent on the size of the system. The overflow should be connected to a roof, or leader, so that the discharge will do no damage.

(2) The vacuum check valve should be 1¼ to 2 in. to prevent a vacuum being formed in the top of the tank and maintaining a false water level in the system that will interfere with the operation of the automatic water feeder. The automatic water feeder is intended to maintain the proper water level at all times in the system automatically. A 1-in. or ¾-in. city connection is all that is necessary. It should be connected as shown so as to equalize.

In the case of the tank placed at the base of the system, the air pressure must be sufficient to overcome the height of the system, plus the pressure at which the pop valve is set. The tank is connected to the return of the pump in both cases with a 2-in. or 2½-in. pipe, depending on the size of the plant. The air pressure is generally provided for other purposes at 100 lbs., which is sufficient. Sometimes a separate Westinghouse air brake pump is utilized for this purpose.

METHOD OF OPERATION.

Following is the method of operation to determine the proper height of the system with the pressure or altitude gauges, and when the pressure is below this point the system needs water. The air pressure valve is opened and the water forced out of the tank into the system.

Air traps, as in Fig. 1 at the high point, relieve the system of any air when requiring water. If the water level in the tank is too low, water is admitted. It is customary, as the tank is placed under the direct charge of the operatives of the plant, not to make these automatic, but to operate them by hand as water is required. The size of the tank in both cases can be determined by the known range in temperature of the water in the system by the cubic feet or number of gallons. The tank should be provided with water gauges of sufficient length so that the water will appear at all times, regardless of the temperature and without producing sufficient additional pressure between the maximum or minimum temperature to open the pop safety valve. Of course, this means a closed system, but the advantage of some pressure at all points is considerable in improving the circulation.

The difficulty of the pumping head being less than the friction head at any point in the system can be overcome by this arrangement.

The tank should be of such a size and capacity that with the complete temperature range in the water the tank will show from one-fourth to one-third full of water. It is readily seen that if the tank is too small the pressure will be too great at the maximum temperature, causing a loss of water through the pop valve.

It is also seen that the pressure at which the pop valve is set determines the maximum temperature of water at which the apparatus may be operated. If set at 5 lbs. over the static head, 215° outboard may be carried. If set at 25 lbs., the water may be operated at a temperature corresponding to steam at a somewhat lower pressure, say 20 lbs., or about 260° F.

Where exhaust steam is utilized under vacuum, the radiation should be so arranged that any temperature over 215° will be unnecessary.

57—Data for Figuring an Indoor Plunge.

QUESTION: Kindly advise me as to what firm or firms can give me the necessary information and apparatus for the installation of an indoor plunge? I wish to heat city main water and filter and reheat the overflow. The tank to be installed will be 35 x 75 ft., with a depth of 3 to 6½ ft. We will expect to raise the temperature from 40° to 80° F. in from 5 to 6 hours. We would also like to know of the most economical filter of sufficient capacity to handle this 12,469 cu. ft. of water every three days. Owing to the high price of our city water, it will be necessary for us to figure re-using the water, providing it can be filtered to a fair degree of purity. We also intend to clean out the pool and to refill it once a week. We should like to know the best means of heating this body of water, whether to use coils, steam jets or steam heaters.

ANSWER: As regards filtering the water, it would require another receptacle of the same size to completely empty the pool in order to purify it by means of a filter. This would mean a 95,000-gal. tank in addition. Filtering a portion of the water by recirculation would not be efficient, and in any case there would be possible products in solution that would pass through any filter unless chemically treated in the passage through such filter.

Regarding the heating of the water, it would make little difference how it is accomplished as it will require the following power:

12,469 cu. ft. x 62½ = 779,312 lbs.

If accomplished in 5½ hrs. from 40° to 80° F., it will require a boiler of the following horsepower:

$$\frac{779{,}312 \times 40}{5.5} = 5{,}667{,}730 \text{ B.T.U. per hour.}$$

$$\frac{5{,}667{,}730}{34.5 \times 1{,}000} = 164.3 \text{ boiler horsepower.}$$

It is readily seen that this is rather an excessive investment for equipment, but if these are the requirements to be met it will take the power stated. If you take 903.65-H.P. capacity for one hour and divide by the time, you can readily determine how large a plant you need to install.

The following are manufacturers of water filters: Loomis-Manning Filter Distributing Co., 1 Madison Avenue, New York; Jas. Beggs & Co., 36 Warren Street, New York; Ross Valve Mfg. Co., Troy, N. Y.

If a separate tank is provided to hold the water to be refiltered, and if the heater and tank are placed on a higher level than the bottom of the pool, it would be best to use an electric-driven pump to raise the water from the plunge to the storage tank and for circulation through the heater. If no pump is used, the heater will have to be placed below the level of the plunge to obtain circulation by gravity.

If steam were available from other sources, a heater could be used with fairly high pressure steam, so arranged that the shell could be placed on a level with the bottom of the pool in a pit and the water recirculated through a shell with the steam in the coil. This would require a smaller pit to be built than if you were providing for firing a boiler. If a steam pressure is available of 10 or 15 lbs., the condensation can be raised out of the pit.

The simplest method would be to place a hot water boiler on a level with the bottom of the pool or below and connect the circulating pipes from the bottom and top. Another method is to inject steam directly into the pool, allowing the condensation to mingle with the water.

In any case, the power required will be as given for the stated time. If the period of heating up is lengthened, the power will be reduced accordingly.

58—Water Troubles in Steam Radiators.

Question: We have rather a perplexing problem here in the way of a steam plant upon which we would like to have a little advice. The boiler is high pressure. The main is taken out of the top of the boiler (vertical type) and is 1½-in. in diameter. This runs along the ceiling from which four radiators are tapped, using 1¼-in. pipes. The return for the condensation is 1¼-in.

All these radiators fill up with water as soon as the steam goes up in the boiler and when it comes down, the water comes back. The upstairs radiators do not fill with water, and they heat all right. The lower radiators are 14 in. higher than the water level. The fact that the water runs back when the pressure is low is an indication, not that the radiators are too low, but that the lead or outlet is too small and allows too much pressure on the water? Is this right and would a 3-in. pipe or a 2½-in. lead pipe obviate this trouble?

Answer: You have stated the difficulty exactly. Where radiators are as close to the water line as stated and any distance away, it is almost impossible to keep them clear of water with more than 2 or 3 lbs. on the boiler. It requires a column of water equal to the difference between the pressure in the radiator and that in the boiler, figured at 0.43 lbs. per foot of height.

It must, of course, be rembered that as the pressure is raised on the boiler this difference in height becomes greater and the increased temperature also causes more condensation or heat emission from the radiator. If the boiler can be operated on a low pressure of 2 or 3 lbs., the supply and amount of radiation may be increased, if not sufficient to do the heating. If the boiler has to be operated on high pressure for other purposes, the most economical method of returning the water is to disconnect the return of the radiator within 14 in. of the water line of the boiler and connect a return trap. This return trap is placed slightly above the water line of the boiler and arranged so that by a dumping movement of the trap, steam is connected directly to the trap, supplying boiler pressure sufficient to cause the water to flow back to the boiler.

While dumping, a check in the main return shuts off the heating system. After the trap dumps, it automatically shuts off the boiler steam and the steam in the trap condenses, allowing the check on the return to open and fill the trap. The operation is then repeated.

The only caution to be taken is to have a separate steam connection between the trap and the boiler, full size called for by the manufacturer, so as to be sure and obtain the full boiler pressure on top of the water in the trap.

If anything else is taken off the line, the pressure is apt to be reduced, causing the trap to stop operating.

LEGAL DECISIONS

Heating Rates—Factors to Be Considered.

A utility filed with the Illinois Public Utility Commission, a schedule of charges for heating water tanks by a steam coil, this charge to be in addition to the regular building heating rates. The city filed a complaint, alleging that the rates were excessive and unreasonable. The facts of the case were as follows:

The company supplied steam-heating service from a central station, and the charge for this service was determined by the kind and size of building heated. The schedule of rates as originally filed did not include a charge for heating hot-water tanks. The rate that the company wished to put into effect was as follows:

30-gallon tank......$15 per heating season
42 " " ...... 20 " " "
60 " " ...... 30 " " "

The city submitted evidence to show (1) the amount of water consumed by the six consumers having hot water tanks; (2) the amount of radiating surface in the heating coil of the tank; and (3) the amount of radiating surface of the tank. Taking either the square feet ot heating surface in the coil or the square feet of radiating surface of the tank as a basis, the city found that the approximate charge for the heating season would be $1 or $1.75 for each tank, depending on the basis used. The company submitted an exhibit wherein the amount of hot water used by the average family was assumed, and on this basis the additional expense to the company caused by the installation of one of these tanks was computed. By this method a cost to the company of $17.06 was arrived at without making allowance for taxes, insurance, interest, etc.

The Commission held that the method adopted by the city in arriving at a rate was based on the erroneous assumption that a square foot of heating surface in air gives off as much heat as a square foot of heating surface in water, and did not take into consideration many of the important factors. The method used by the company was predicated on a more correct basis, but it was subject to the criticism that many assumptions were necessary to complete the computations. Of the two, the method used by the company was held far more acceptable. Any change computed in advance must of necessity be based on assumptions, and those used by the company appeared to be fairly reasonable. The schedule was therefore approved.—City of Taylorville vs. Central Illinois Public Service Co., Illinois Public Utilities Commission.

Infringement of Furnace Regulator Patent —Preliminary Injunction.

Suit was brought for infringement of patents Nos. 817,438 and 826,349 for method of regulation of furnaces. Suit had previously been brought against the Hotel Astor, New York, which was the user of a particular furnace regulator, which it was alleged infringed the patents. That suit was defended by the defendant in the present suit, which makes devices which the complainant contends infringe its patent. In the suit again the Hotel Astor infringement was found. In the present suit the defendant denied that it was offering the same system and apparatus as the complainant's, but admitted that it was the defendant which installed the apparatus in the Hotel Astor. That being so, it was held to be within the discretion of the court to grant a preliminary injunction. If the defendant's regulators did not infringe, the injunction did not cover them.—Engineer Co. vs. Blaisdell Canady Co., C. C. A., 220 Fed. 673.

Ventilation of Street Cars.

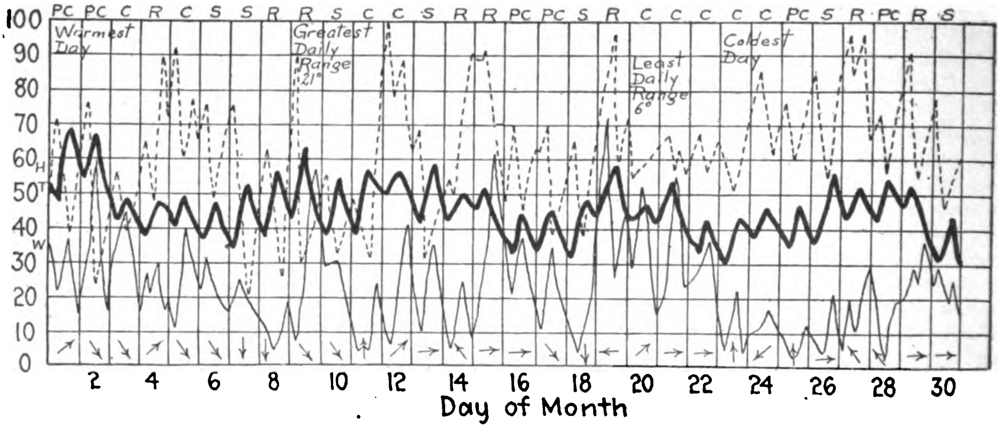
Chicago Code 1911, Sec. 2210, requires street cars to be so ventilated that the carbonic acid present in the air therein shall not exceed 10 parts in each 10,000 parts of air. In a prosecution for a violation of the ordinance the evidence showed that there was another ventilating system in use in Chicago on cars operated by others than the defendant, whereby the requirements of the ordinance were complied with. A finding of not guilty by the trial court was, on appeal, held evidently to have been based on the theory that the violation was not intentional and that the defendant had done its best to comply with the ordinance.—Chicago vs. Chicago City Ry. Co., 192 Ill. App. 1.

Current Heating and Ventilating Literature.

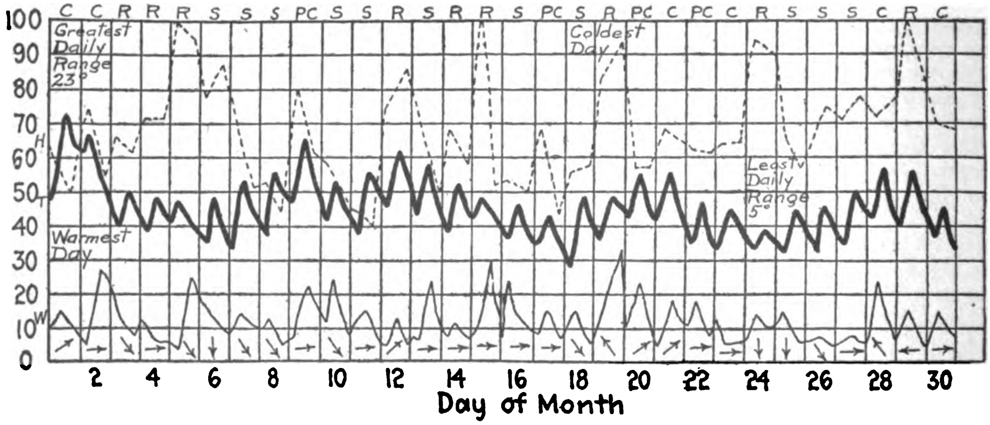
Underground Heating. Design, construction and operation of systems from central plant. 1,200 w. Prac. Engr., Chicago—Oct. 1, 1915. 20c.

The Weather for November, 1915.

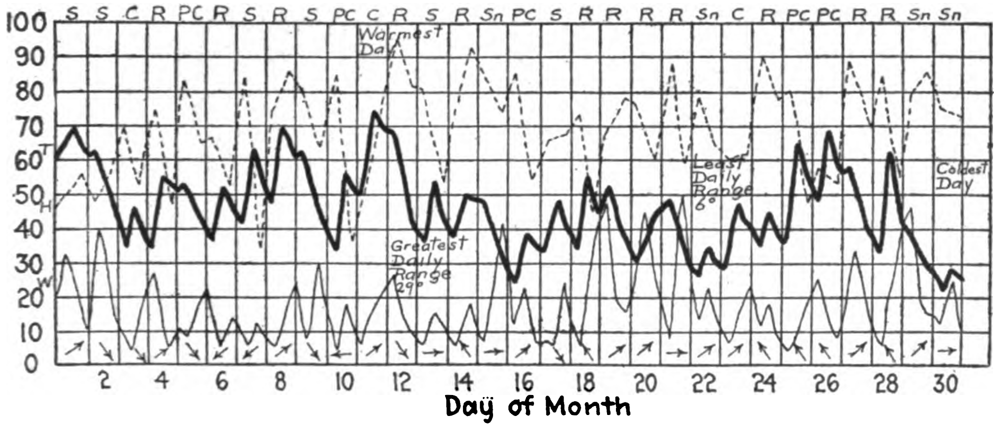
	New York.	Boston.	Pittsburgh.	Chicago.	St. Louis.
Highest temperature, degrees F.	68	72	74	75	81
Date of highest temperature	1st	1st	11th	7th	6th
Lowest temperature, degrees F.	30	29	22	23	23
Date of lowest temperature	23d	18th	30th	30th	15th
Greatest daily range, degrees F.	21	23	29	26	34
Date of greatest daily range	9th	1st	12th	11th	20th
Lowest daily range, degrees F.	6	5	6	2	7
Date of lowest daily range	20th	24th	22d	15th	19th
Normal temperature for month, degrees F.	45.4	45	45	44.2	50.9
Normal mean temperature for month, deg. F.	44	41.2	42.9	39.2	43.4
Total rainfall, inches	1.09	2.14	2.37	2.03	1.97
Total snowfall, inches	Trace	0.2	0.4	0.7	Trace
Normal precipitation this month, inches	3.44	4.1	2.55	2.5	2.88
Total wind movement, miles	13,915	8,046	9,468	10,720	11,811
Average hourly wind velocity, miles	19.3	11.2	13.2	14.9	16.4
Prevailing direction of wind	N.W.	W.	S.W.	W.	S.
Number of clear days	7	13	8	9	11
Number of partly cloudy days	9	5	7	10	10
Number of cloudy days	14	12	15	11	9
Number of days on which rain fell	9	9	16	12	6
Number of days on which snow fell	..	1	4	3	..
Snow on ground at end of month, inches	..	..	Trace	Trace	..



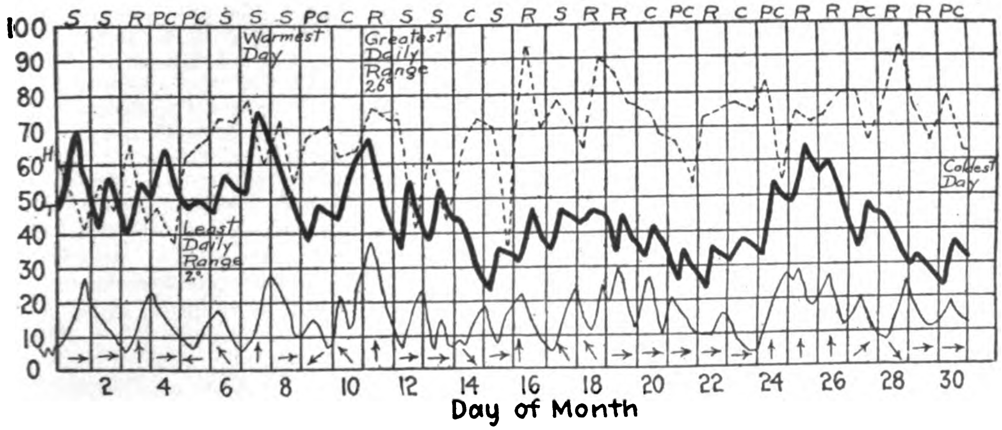
RECORD OF THE WEATHER IN NEW YORK FOR NOVEMBER, 1915.
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



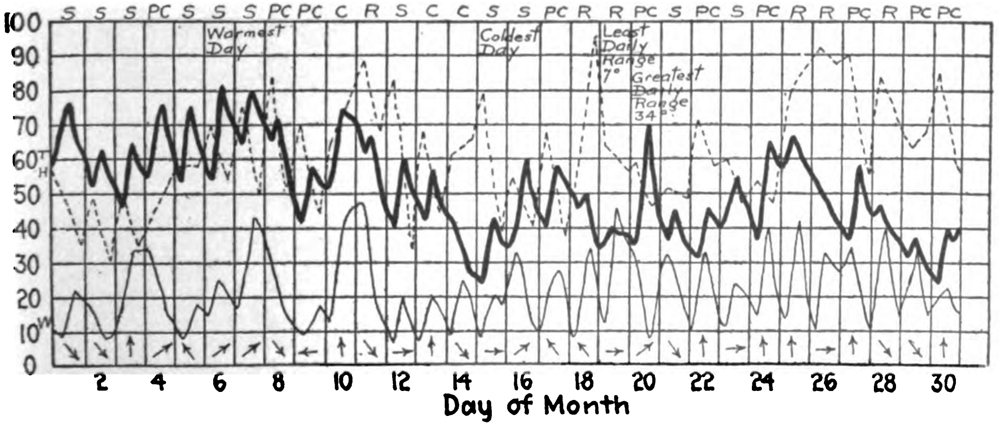
RECORD OF THE WEATHER IN BOSTON FOR NOVEMBER, 1915.



RECORD OF THE WEATHER IN PITTSBURGH FOR NOVEMBER, 1915.



RECORD OF THE WEATHER IN CHICAGO FOR NOVEMBER, 1915.



RECORD OF THE WEATHER IN ST. LOUIS FOR NOVEMBER, 1915 .

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 3 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Discusses Vapor and Vacuum Heating Systems

Vacuum and vapor heating systems came in for a lengthy discussion at the December meeting of the New York Chapter, which was held December 13 at the Engineering Societies' Building. The principal speakers were T. F. Hynes, of the Bishop-Babcock-Becker Co., and James A. Donnelly, of the Positive Differential System Co. Others who took part in the discussion were A. M. Feldman, President A. J. Driscoll and Secretary F. K. Davis.

Mr. Hynes, the first speaker, began his remarks by referring to the matter of comparative efficiency of various heating systems.

GRAVITY STEAM HEATING TYPE PLANTS VS. VAPOR.

In the one-pipe gravity plant, he said, it is usually necessary to tax the boiler with the lessened efficiency due to a back-flow of condensation against steam travel. Pressure must be carried at all times to insure circulation. The restricted venting devices ordinarily used air-bind the system, and cold sections prevent full efficiency. There is very little variation in temperature to adapt to mild, moderate or extreme weather conditions. The intense firing necessary creates clinkers, and results in flue gas wastage. High temperatures strain connections to radiation, and in the pipe and fittings. The one-pipe job is sluggish and it is characterized by a fickle boiler water line, resulting in lessened boiler life and the destruction of fullest efficiency by drops in temperature and pressure in the steam supply to the radiation.

In two-pipe gravity jobs the losses from the venting devices in drip and evaporation occur as in the one-pipe gravity system. This results in escape of obnoxious odors and creates an undesirable humidity in the room's atmosphere. There is very little flexibility and pure wastage results from resort to outside ventilation to overcome a superheated condition in moderate weather and in the milder climates.

HOT WATER VS. VAPOR HEATING.

Hot water plants are adapted in size to match those in which vapor systems are usually installed. The hot water plant is not desirable for severe climates, or where there is much glass surface or leakages to contend with, on account of the low temperature efficiency, which is not comparable to vapor or steam to meet the requirements of the modern industrial plant or commercial building where the highest labor efficiency is dependent on adequate heating for comfort. In many installations the sluggish hot water system, especially where intermittent heating is necessary, only gives the highest efficiency after the need of heat is over with increasing warmth of the day. There are five to eight times the hot water volume to heat that there is on a vapor job and the retention of the temperature when this large quantity of water is heated wastes fuel and labor when heat is not desired. Valved-off units suddenly put into service interfere with the efficiency of the entire plant. Hot water heating is not retaining its one-time popularity, said Mr. Hynes, the greater economy, flexibility and efficiency of vapor system relegating it into the background.

OTHER ADVANTAGES OF VAPOR HEATING.

The vapor method of heating is adapted for small or medium-sized heating jobs where mechanical vacuum operation would, by reason of first cost, prove prohibitive. This method may also be used advantageously in the largest buildings where the condensation is wasted, or where a gravity return to boiler is procurable. In the larger heating jobs, whether operated on low-pressure boilers or run-off exhaust or live steam, it is our opinion that an automatically controlled vacuum pump is more desirable than a vapor installation. Vapor heating is based on the principle of securing slight initial pressure-checking, condensing steam or vapor, and holding a vacuum by sealing against atmosphere.

The vapor system of heating is distinguished by its great flexibility in individual radiator control, its convenience, quick and silent result, economy, and the added slight increase in first cost being justified by these advantages over straight gravity or hot water types of heating plants.

It is the practice of the Bishop-Babcock-Becker Company to use a packless graduated valve, quick-opening with quarter turn, self-cleaning, and requiring no adjustments for various sizes of heating units. At the return end of radiator a thermostatic trap is installed to vent, relieve condensation and trap the steam in the heating unit. Pressure does not extend to the return lines, and no delicate adjustments are necessary on the supply end. It is the company's opinion that under the varying conditions in a heating plant it is not feasible to make a permanent modulating valve adjustment which will give uniform and good service in supplying the exact amount of steam which a radiator will condense. The company rates the radiation under ordinary conditions about 10% in excess of gravity rating, and the boiler about 20% in excess of straight gravity. This means reasonable first cost, and has been demonstrated sufficient. The end of supply main is freely vented with a thermostatic vacu-check valve,' which prevents steam escaping, and the check prevents air being forced into the ends of supply mains from the dry return.

A vacu-vapor vent valve of large capacity allows free venting at ends of dry return circuits and from the supply main and seals against atmosphere, at the same time retaining the vacuum created in the system by condensing.

If accidental pressure is attained and condensation backs up in the vent lines, a static head overcomes the boiler pressure, and the condensation flows by gravity through a balanced or swing check valve back to the boiler. A sensitive and positive damper regulator is used. Reasonable first cost, simplicity, economy and efficiency characterize this system in actual service. The satisfaction of the users and of the heating engineers with the vapor type heating plant is proven by the greater increase over all others in the numbers of vapor installations being made in recent years, and like progress is seemingly assured for the future.

In discussing some of the points brought up by Mr. Hynes, Secretary F. K. Davis said that the statement regarding the comparative lower efficiency of hot water heating in large buildings does not seem to be what we might expect, in view of the large plants equipped with forced hot water heating systems. In many of these plants, he said, the water is hotter than steam would be in a vapor or vacuum heating job, as the temperature of the water is often at 240° F., while steam would seldom be above 214°. Mr. Davis also called attention to the fact that vapor heating has been applied in very large buildings, containing, in some cases, as much as 60,000 sq. ft. of radiation.

CAUSE OF HIGH VACUUMS.

Speaking of high vacuums, Mr. Davis believed that in vapor systems these were due to large returns. The return mains are usually left uncovered and present large cooling surfaces. There are some systems that use several sections of radiation to condense the vapor in the returns.

James A. Donnelly stated that there is a decided advantage in a system that allows the heating of units to be increased or decreased to meet the desires of various people. Especially is this true in the heating of houses where there may be children, or sickness, in which case much more heat might be necessary in one portion of the house than in another.

EXPULSION OF AIR ESSENTIAL.

Concerning a vacuum on a gravity job, Mr. Donnelly said it was always essential to expel all the air from the system as completely as possible when the plant is first started, in order to get a reasonable vacuum. Thermostatic valves on the outlets of radiators, in Mr. Donnelly's opinion, offer but negative results, as they leave all the air in the return between the outlet of the radiator and the water line of the boiler. The previous speaker mentioned as a cause of vacuum in vapor work, the contraction of the air in the return line as it cooled. The expansion of air under a vacuum, said Mr. Donnelly, would be many times greater than its contraction, due to a decreased temperature. Some years ago, Mr. Hoffman brought up the question as to why cold spots developed in sections of vacuum systems. The explanation was that with complete circulation through the steam and return mains, it could hardly be expected that more than 90% of the air would be removed. If 10% of the air is left in, and we drop the pressure to 20 in. of vacuum, we will then have 30% of air in the system. According to tests, it has been found that the air collects one time at one portion and another time at another portion of the system.

Mr. Donnelly referred to a paper he had presented at a meeting of the National District Heating Association, giving a comparison of operating conditions and the amounts of vacuum that it is necessary to maintain in order not to overheat a building. The amount of vacuum necessary for this purpose increases very rapidly for a comparatively slight rise in the outside temperature. A vacuum of 18 in., for instance, becomes necessary when the outside temperature is 25° above zero, if the radiation is sufficient to heat the building at atmosphere in zero weather. Thus, it would be very difficult to keep from overheating the building by this method alone and it is considered much better practice to control the heating effect of a radiator by heating a portion of it by means of a fractional system, than to attempt to heat all of the radiator but to reduce its temperature in relation to the outside temperature by carrying a varying vacuum within it.

The manufacturers of vacuum air valves, added Mr. Donnelly, have never designed and placed on the market a damper regulator for maintaining the pressure in the boiler at any particular degree of vacuum. The usual practice is to bank the fire and drop to as low a vacuum as possible. Then the house gradually becomes cold, instead of being maintained at the proper temperature.

EXHIBIT OF OLD-STYLE VACUUM VALVES.

At this point, President Driscoll announced that Mr. Donnelly had brought to the meeting a number of old-style vacuum valves, including the original vacuum system valve, which could be inspected by all present. Mr. Donnelly said that he began collecting these valves some years ago. He said he was ready to present the collection, through the New York Chapter, to any college, to be preserved, similar to the historic collection of incandescent lamps of all makes.

Speaking broadly on the subject of the evening, Mr. Donnelly said:

REVIEW OF VACUUM HEATING PRACTICE.

"I have had experience with a number of systems, beginning with the Williames system, about 25 years ago. Later I put in some of the first Paul air line systems, at the time the system was introduced in Boston. A year or so after this I put in some of the first plants which used the rubber thermostatic valve. This type lasted for some time, from about 1894 to 1901. It was succeeded by the pressure motor type, one design being of my patent, the other being introduced by Messrs. Paul and Kinealy.

"After these came the float valves, in many types and sizes. The vaporized fluid valve succeeded these. The first use of vaporizing fluid valves, applied to each individual radiator, was as a vapor or air-return system, with open vent returns. They had been tried experimentally some years before by the company which controlled the use of the rubber thermostatic valve, but it was stated by them that they were only good for one pressure and temperature; that any increase in the pressure would cause them to hold up water, and any decrease in the pressure would allow them to blow steam. I believe that the successful introduction of the Dunham valve for vacuum return line systems has shown that this difficulty may be overcome.

"The first use of fractional or modulating valves on the inlet of the radiator was an attempt to control not only the partial heating of the radiator, but the total steam admitted, restricting the maximum opening of the valve to that required for the total heating of the radiator. I believe it is now considered much better practice to make the maximum opening of the fractional valve large enough to heat the radiator very quickly, and to use some form of automatic appliance to prevent or restrict to the proper amount the flow of steam to the returns.

VAPORIZING FLUID VALVES.

"The many interesting designs of vaporizing fluid valves that are now in use are capable of furnishing material for some varied discussion. Broadly speaking, there are two large classes: those having the vaporizing fluid on the inlet, that is, between the radiator and the valve seat; and those having the vaporizing fluid on the outlet, that is, beyond the valve seat. Though both types of valve have a certain range in temperature through which they may operate very well, there must be one particular temperature and pressure at which each will operate best. This might be called the temperature for which they are designed. Those having the container on the inlet would, therefore, work best where a constant and uniform steam pressure was maintained in all the radiators, while those with the container, beyond the valve seat, where a constant and uniform vacuum was maintained at the outlet of all the radiators.

"Therefore, if the steam pressure varied in different buildings or in different portions of the plant, it might be well to vary somewhat the valves that were used. Likewise, if the amount of vacuum varied in different parts of the return system, it would be necessary to have the containers holding the vaporizing fluid vary in the same way that the vacuum carried varies. Some of these valves are made with a means of adjustment so that the action of the valves may be modified to a certain extent, and it might be a profitable topic for discussion as to whether or not all valves should be provided with means for adjustment.

PIPE SIZES MUST BE AMPLE.

"When vacuum return line systems were first introduced, the sizes of both the steam and return pipes were made very small. It has been interesting to follow the changes that have since been made in them in bringing them back to a more conservative standard. Many of the early systems had vacuums as high as 20 in. to 23 in. at the pump, produced by a liberal use of jet water, although the return pipes were so small that this vacuum frequently dropped to 3 or 4 in. at points 1,200 to 1,500 ft. from the pump. In like manner, with a steam pressure of ½ lb. to 1 lb. at the source of supply, the friction of the flow would be so great that 2 in. of vacuum would often be found in the steam main at the extreme end of the line.

"When piston and float valves were first introduced, it was found that they must be made to operate very easily and practically without friction, so that the low difference in pressure at the extreme end of the system would operate them. Therefore, when they were subjected to the high difference in pressure near the pump, they operated very quickly and were very noisy. This caused a considerable increase in the size of the return lines, so that even with jet water, it was not possible to get more than 6 in. or 8 in. of vacuum at the pump, but this vacuum would extend to the farthest point of the main return line practically without drop. In this manner, a lower and more uniform difference in pressure was maintained, which improved the action of the apparatus very much.

"It has been found that with vaporizing fluid or thermostatic valves, it is commercially better engineering practice to use smaller returns. Where this is done, in case some of the containers crack or leak, or are held open by dirt in the seat, allowing steam to be admitted to the returns in considerable quantities, it is possible to maintain a very much higher vacuum by the use of jet water than if the return piping is large.

"I think it will be conceded that where a plant is continuously operated and where radiators are not closed off or turned on, an orifice at the outlet of each radiator, such as was originally used in the Williames system, provided it will not be stopped up with dirt, will produce perfect circulation. It is only necessary to proportion the orifice for two things: the size of the radiator and the distance from the source of supply. Automatic valves of float or thermostatic type, where the plant is in continuous operation, would also maintain an average orifice of the same size as the first described. In plants where check valves, with restricted seats, are used at the outlet of all radiators, in combination with a similar valve in each branch return, the proper adjustment of these valves produces a combined effect exactly parallel to the previous methods described.

"In claiming many new points of superiority for the vapor system, we should not lose sight of the fact that the old gravity system had some good features also. One of the good points of the gravity system is that it can be operated at any pressure with a very simple damper regulator, and that it does not require special apparatus at the boiler for the purpose of returning the water of condensation. I believe, however, that the modern vapor system, which can operate at any pressure, is certainly superior to one which can only be operated at an extremely low steam pressure.

"Quite recently I stated to an architect that a good one-pipe system would cost more than a fractional vapor system. A good one-pipe system should have two radiators in a room, while a vapor system, with fractional control, needs only one. The air valves of a one-pipe system should be piped to the cellar in order to eliminate the many annoyances which they cause. A comparison of competitive figures on this basis will show that a vapor system may be installed more cheaply than a first-class one-pipe system."

In connection with the plans of the chapter's entertainment committee, it was announced that the annual dinner of the society would be held this year at the Hotel Astor. The New York Chapter, the society and President D. D. Kimball have each appropriated $100.00 to the entertainment fund, so that there will be no popular subscription to the fund this year.

The proposed amendment to the chapter's constitution regarding the method of electing members was adopted.

It was voted to refer to the society a report that had been prepared by a chapter committee recommending changes in the society's constitution.

Illinois Chapter Hears Address on the Use of Gas for Heating Purposes.

A timely address on the utility of gas for heating and for industrial work was presented at the December meeting of the Illinois Chapter by Frank F. Cauley, manager of the industrial appliance division of the People's Gas Light & Coke Co. of Chicago. The meeting was held at the Morrison Hotel, Chicago, December 13. Mr. Cauley's talk was illustrated by stereopticon slides showing, among other things, the use of gas as a fuel for steam boilers, ranging from 3 to 20 H.P.

Although the address was largely devoted to the industrial uses of gas in metal melting furnaces, etc., there was much to interest the heating engineer in view of the possible use of gas heat for warming purposes during the milder winter weather. One of the interesting statements made by Mr. Cauley was that his company is now at work on a sliding scale of rates for gas used for heating purposes, indicating that there might be some reduction of the gas rates in Chicago.

In connection with the business session of the chapter a committee, consisting of E. J. Claffey, G. I. Cook and J. H. Davis, was appointed to secure a large attendance from Illinois at the annual meeting of the society in New York, January 18-20.

Massachusetts Chapter.

Andrew G. Paul was the principal speaker at the December meeting of the Massachusetts Chapter, held at the American House, Boston, December 14. Mr. Paul, who has recovered from a recent illness, had found time to invent and perfect a number of heating specialties and he gave the chapter an interesting talk on the construction and application of these specialties. The meeting was preceded by a chapter dinner and, in the absence of President E. N. Stone, was presided over by F. S. Boltz.

A special committee was appointed to secure as large an attendance as possible at the society's annual meeting in January. It was announced that the January meeting of the chapter will be held in New York in connection with the society's meeting.

Arrangements for Annual Meeting.

A program that will fill every available minute has been arranged for the annual meeting of the American Society of Heating and Ventilating Engineers, to be held in New York, January 18-20. The sessions will be held as usual in the Engineering Societies Building, 29 West 39th street, and the society dinner, on the evening of January 19, will be held at the Hotel Astor.

The papers and reports scheduled to date include the following:

"Tests on the Recirculation of Washed Air," by G. L. Larson.

"Heating and Ventilating Plant, Waite High School, Toledo, Ohio," by Samuel R. Lewis.

Report on the establishment of standard heating elements for cooking apparatus, with special reference to low pressure steam, by D. S. Boyden.

Report on the establishment of a standard co-efficient for heat losses affected by wind movement, by H. W. Whitten and R. C. March.

(The two foregoing reports were part of a report of a joint educational committee of the heating engineers' society and the National District Heating Association, and were presented at the annual meeting of the latter association in Chicago last June.)

"Cost of Opening Streets for Pipe Trenches," by W. F. Verner.

"Heating Industrial Plants," by J. F. Cyphers.

"Office Building Operating Costs," by George W. Martin.

"Air Leakage Through Windows," by Henry C. Meyer, Jr.

"Transmission of Heat in Warm Air Furnaces," by John R. Allen.

"The Testing Institute at Berlin, Germany," by Arthur K. Ohmes.

"Heating of the Commonwealth Edison Building, Chicago," by S. Morgan Bushnell, being a description of the plant and tabulation of operating costs.

"Heating and Ventilating Plant for the Equitable Building, New York," by W. H. Driscoll.

"Report on the Work of the New York State Ventilation Commission," by George C. Palmer.

"Ventilation of Homes," by the Chicago Ventilation Commission.

"Can We Standardize the Requirements of Ventilation," by J. J. Blackmore.

The papers and reports here given will all be presented at the meeting, but not in the same order.

The entertainment committee of the New York Chapter, headed by J. I. Lyle, will have many delightful treats in store for the ladies, as well as for the members themselves.

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American Society of Mechanical Engineers.

An attendance of 1370 members and guests was registered at the thirty-sixth annual meeting of the American Society of Mechanical Engineers, held in New York, December 7-10. Among the papers of special interest to heating engineers were the following:

"Heating by Forced Circulation of Hot Water in Textile Mills," by Albert G. Duncan.

"The Heat Insulating Properties of Commercial Steam Pipe Coverings," by L. B. McMillan.

"Proportioning Chimneys on a Gas Basis," by A. L. Menzin.

D. S. Jacobus, of New York, was elected president of the society, succeeding John A. Brashear. The new vice-presidents are William B. Jackson, Chicago; J. Sellers Bancroft, Philadelphia, and Julian Kennedy, Pittsburgh; managers: John H. Barr, New York; John A. Stevens, Lowell, Mass., and H. de B. Parsons, New York; treasurer, William H. Wiley, New York.

The society has issued a new edition of the boiler code which contains a comprehensive index. The index is divided into two parts, one a general index to the complete rules and the other containing sectional indexes to the parts referring to new installations of power boilers, new installations of heating boilers, and existing installations.

A proposal made by the publication committee to make the society's "Journal" a semi-monthly or a weekly, instead of a monthly publication, was indorsed by the council, to take effect as soon as the amount of matter to be handled requires it and the funds for that purpose are available.

Trade Commission Extending Export Inquiry.

The Federal Trade Commission announces that it will soon send out 30,000 letters of inquiry, followed up by a brief schedule, as a part of the investigation of conditions that affect American foreign trade. Congress has empowered the commission to make an investigation of these conditions and to report the facts with such recommendations as it deems advisable.

An interesting item of news in this connection is that more than twenty nations are represented by visitors to the United States who are now making their headquarters at the branch offices of the Bureau of Foreign and Domestic Commerce, in Washington, and who are seeking new trade relations.

Advantages of Winter Building.

In a circular published by the Detroit Steel Products Company, advocating a campaign for more building in the winter time, the writer says, among other things:

The question of winter building is one that of necessity must be decided by the owner himself and he is generally not sufficiently informed to take the chance. All kinds of mason work are now carried on successfully at all times during the winter. Buildings of reinforced concrete, depending almost entirely upon concrete for support, are erected in the dead of winter. Mortar will not set as rapidly in winter as in summer, but mortar used in winter will become more durable than mortar used in summer. One reason for this may be that brickwork laid in summer absorbs the moisture from the mortar before it has had time to set.

It is an accepted opinion of the public that contracts for winter work can be let at a lower price than at any other time of the year; all things being normal. It is probable that about 10 per cent. of the cost of the building can be saved if contracts are let during the winter.

The man who erects his building in the winter has the advantage of securing the higher class of workmanship represented by the more competent mechanics who are kept on the payroll during that period. Furthermore, as the contractor and architect are not rushed with the same amount of work as in the summer, each can devote more of his individual time to the construction of the building.

BETTER WOODWORK IS POSSIBLE.

All woodwork which enters into construction of a building is far superior when installed during cold weather, the atmosphere being much dryer than in summer. Much of the moisture in the form of rain which is absorbed by the rough woodwork during warm weather, becomes snow in winter and is easily cleaned off before any material damage can be done. The moisture absorbed by the rough woodwork in summer will not dry out until sometime after the building is completed and decorated. When this moisture dries out floors and partitions often settle, causing cracks and other defects.

One of the greatest objections to summer building is the absorption of moisture from the air by the interior wood finish. This interior finish is one of the most important features of a building, and greater care and skill must be employed in its installation than with any other part of a building. It is always subject to more close inspection as long as a building stands, and it is important that every precaution should be employed to preserve the highest class of workmanship in the building as a whole. The moisture absorbed by the finish woodwork in summer will dry out later and cause joints to open, doors to shrink, panels to crack, and the work to assure the character of a building that literally has been thrown together. On the other hand, heat is maintained in the building erected in the winter, and, as a result, moisture is kept out and the finish remains in a first class condition.

Operating Costs of Steam and Furnace Heating Plants.

For over a year past the Joliet, Ill., school board which has been making an efficiency test of steam as compared with furnace heated school buildings, has made a report, showing that the furnace blast system is 39½% cheaper in operation than the steam plant, in addition to being more than 25% cheaper at installation.

The figures just made public by Superintendent R. O. Stoops, show that taking three modern steam plants and a like number of furnace blast systems, the comparison favors the furnace blast plants. In both cases the humidity control is taken care of. The essential difference is that in the case of the furnace system, the moisture is introduced into the hot air and the mixed product is conducted throughout the building. In the case of the steam plant, the air to be heated, is drawn through coils, entailing more power and incidentally more coal, at $2.67 per ton.

The report shows that the board installed the new type of plant, more than a year ago, with heat regulation and humidity control, and that the plant has now been in operation for a year, making comparisons possible.

FIGURES IN DETAIL.

Cost of heating—furnace blast:

Moran Street, power and fuel per 1,000 cu. ft., $1.563; Broadway, $1.836; Woodland, $1.868. Average cost, $1.755.

Cost of heating—steam blast:

Sheridan school, per 1,000 cu. ft., $2.343; Eliza Kelly, $1.733; Henderson, $3.266. Average cost per 1,000 cu. ft., $2.447.

The report continues: "This shows that the best steam plant costs only 0.135 less to operate than the poorest furnace plant. Local conditions show that this furnace plant (Woodland school) is not doing its best. The above shows that steam costs 39½% more to operate than furnace."

Interest centers in the report in that Plainfield and Aurora have adopted the Joliet system, which, when first installed in Joliet, was untried in this section.

COST OF HEATING PLANTS.

Steam—Sheridan, $5,700; Henderson, $5,560; Eliza Kelly, $6,565. Average per school, $5,941. This does not include all the items of installation.

Furnace blast—Woodland, Moran and Broadway, $14,725, including heat regulation and humidity control. Average per school, $4,925. When this contract was let the job was lumped to one concern.

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Experiences With Humidity.

By A. Bement.

Having had an extended experience with the use of steam, taken from the steam heating system in my home, for the purpose of supplying a desirable condition of humidity during the heating season, as well as a much more general experience with steam used elsewhere for the same purpose, a few words regarding that experience may be of interest.

In The Heating and Ventilating Magazine for January, 1915, at page 24, Dr. Thomas Hubbard says that it is hardly practicable to evaporate sufficient water by means of pans on radiators and registers. This I find to be true to a much greater extent than often realized, also that people often feel that if they keep the pans full of water that they must be getting results, while as a matter of fact such people usually enjoy so little benefit from humidity that they have but a slight idea what it really is.

Dr. Hubbard states that the use of steam is objectionable because of the odor and noise. With reference to the matter of odor, it is my experience that when a radiator or piping is opened for the first time, there is some odor, but that it soon ceases. In my experience in many cases where steam is taken from systems supplied with exhaust steam, and where boiler compound is used, there has not been any case where odor has been an objectionable feature when steam is used for humidification. As to the noise, there is now manufactured a discharge nozzle which emits steam with neither noise or water.

It is my experience that in the central west, the comfortable indoor temperature in the coldest weather may range from 60° to 80° F., depending on the humidity. Comfort at 60°, of course, means high humidity, while 65° represents a more conservative condition. I have frequently changed a temperature of 58° or 60°, prevalent on a winter morning before radiators were turned on, into a comfortably warm condition by raising the humidity without heating.

On two similar cold days, I started in the morning with all radiators on and plenty of steam, but with no moisture supply. At 12:30 noon a comfortable temperature was attained. The next morning the start was made with humidity and the principal radiators air bound by closing the air valves, so that they were half cold. At 8 o'clock A.M. the same comfortable temperature had been attained as was reached several hours later on the previous day. On the first day dry air at 79° insured sufficient warmth, on the second, with humidity, 59° temperature gave the same result.

PRECAUTION IN USING WET AND DRY BULB THERMOMETERS.

In using the wet and dry bulb thermometers of the stationary type, I have found it absolutely essential to direct a strong current of air on them during the reading, as it is only in this way that a proper evaporation on the wet bulb can be secured. I have found for all practical purposes that the readings of the ordinary dry bulb thermometer is a sufficient guide to the prevailing humidity. For example, if 75° to 80° are required for warmth, it is an indication of dry air. If we feel cold at 70°, we know that the humidity is low, but if too warm at that temperature, it is an indication of considerable moisture, and that the temperature should be lowered. Comfort at 65° indicates a good condition. The air with sufficient humidity at temperatures of 60° to 65° is balmy and delightful.

The effect of humidity on the condition of the air is a very interesting one. I have found in crowded offices, with low humidity, where bad air was noticeable by odor, that conditions have been entirely changed by the supply of sufficient moisture. This required the lowering of the temperature, with the result that evidence of bad air disappeared without additional ventilation.

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Comparative Test of Water Heaters.

A comparative test made recently in Montreal between a No. 5 Old Style Presto heater and a similar heater of another make, disclosed some interesting data regarding the efficiency of this type for hot water heating systems, which was shown to be superior.

The tests were made under regular working conditions on a heating system already installed, in the Recreation Hall of the College of Montreal, and were conducted by Prof. A. Dollo of the Montreal Polytechnic School and A. D. Peck, consulting engineer.

Fig. 1 shows the plan and elevation of the installation of both heaters.

The temperature of the hall at the beginning of the test was 61° F. The temperature of the circulating water was 60° F. The number of cubic feet in the hall to be heated was 311,202; radiator surface used, 4,297 sq. ft., equivalent to 12,892 lineal feet of 1-in. pipe. This gives 72.42 cu. ft. of air per square foot of radiator surface, or 24.13 cu. ft. of air per lineal foot of 1-in. pipe. The boiler was run under a mean pressure of 80 lbs.

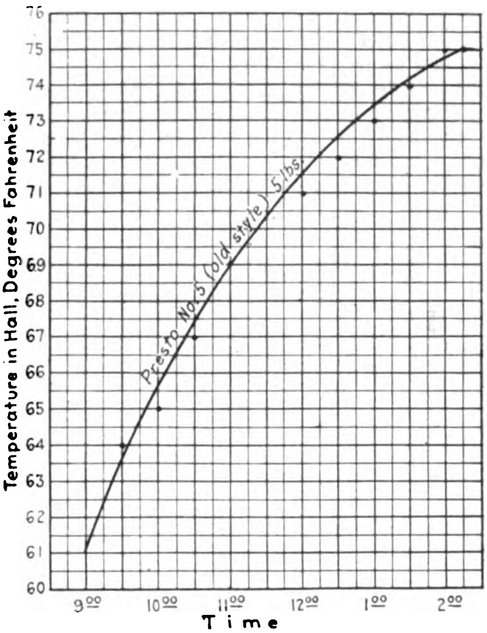

FIG. 2.—CURVE SHOWING RATE OF TEMPERATURE RISE IN HALL.

The mean temperature of the hall during the run was 70.07° F. The maximum inside steam pressure irrespective of steam pressure was 75° F. Fig. 2 is the curve between time and temperature in the hall.

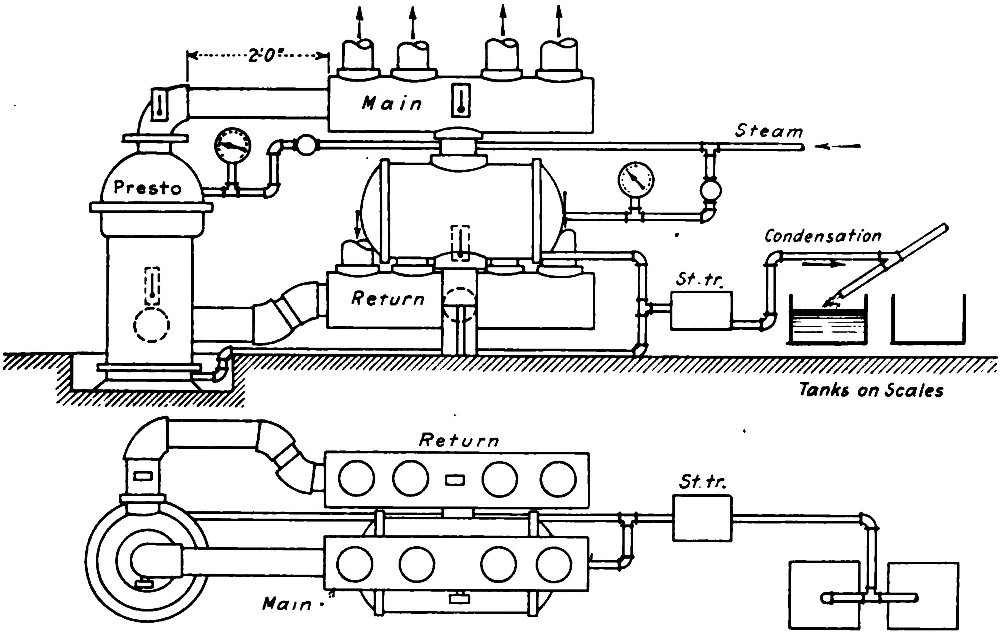

FIG. 1.—PLAN AND ELEVATION OF TEST INSTALLATION.

DURATION OF TEST AND HEAT IN MAIN.

A maximum temperature, at 5 lbs. pressure, of 167° was obtained in the main with the Presto heater after 5 hrs. 20 min. Fig. 3 is a curve drawn between time and temperature in the main. It will be noted that there is a break in the curve from A to B. This is due to the water in the heating system circulating, the hot water going out and the cold water coming in. It will also be seen from the curve in connection with the velocity of circulation that it took 30 min. to pass all the water of the heating system through the heater.

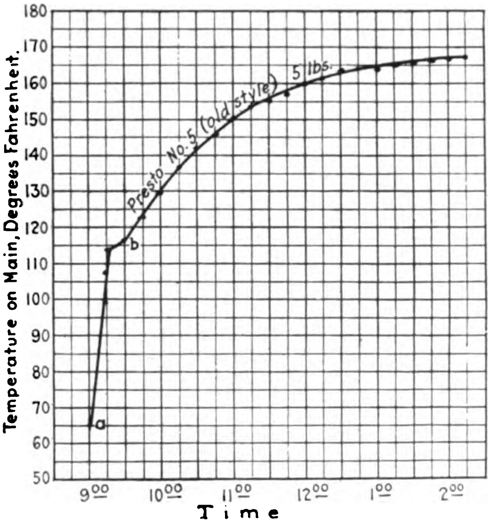

FIG. 3.—CURVE SHOWING RATE OF TEMPERATURE RISE IN THE MAIN.

The total condensation for the heater was 3,879 lbs., the heater using 12.12 lbs. of steam per minute. The total required horse power for the run was 115.13 B. H. P.

Following is a summary of the results obtained with the Presto heater (No. 5, old style):

Square feet of heating surface......	38.07
Mean temperature in hall, deg. F.....	70.07
Mean outside temperature, deg. F.....	54.46
Maximum steam pressure used, lbs....	5.
Maximum temperature in mains at 5 lbs., deg. F........................	167.
Duration of test to obtain maximum temperature in main, hrs...........	5.33
Total condensation, pounds...........	3879.
Total boiler horse power used.........	115.13

The Presto heater is manufactured by the Harris Construction Co., Ltd., Montreal, Can., and its showing in this test, where it produced the higher results, is followed by a statement from the manufacturers that they are prepared to make a test of the same nature with any other kind of heater on the market.

CORRESPONDENCE

Contractors' Guarantee of Heating Installations.

Editor HEATING AND VENTILATING MAGAZINE:

We are suing a man on account of some additional radiation that we put in his residence last winter, as he said the house was not warm enough to suit him. After the work was all done he refused to pay for it as he said it was up to us to heat the house to 70° inside, when the outside temperature was 10° below zero, according to the original plans and specifications, and the architects are upholding him in his contention.

The architects had a heating engineer lay out the plans and write the specifications for them, showing the size of the pipes and the location of the radiators, etc., and we installed the system in strict accordance with the layout. The work was completed in the spring of 1912, and the following winter the owner decided he wanted more radiation and it was put in by us and paid for by the engineering firm.

We desire to know if you have any record of similar cases that were settled in the courts and what the outcome of them was.

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This matter has been up for debate many times before the heating engineers' society and other bodies. The following is one of the most recent decisions having a bearing on the subject:

GUARANTY OF CAPACITY OF HEATING PLANT.

In an action against a contractor for breach of his agreement to install a heating plant sufficient to heat a building to a certain temperature in cold weather, the plaintiff sought to recover for additional expense of employing another party to remedy the plant. It was held that under the contract and the evidence the defendant was liable for at least nominal damages, but that a judgment could not be sustained for the cost of completing the plant in the absence of evidence showing that the additional work and materials furnished were necessarily required to make the plant comply with the contract. It was also held that the contractor was liable on his guaranty though the owner had him place seats over some of the radiators, the contract expressly giving the owner the right to make such changes, to be paid for as extras, without invalidating the contract, and the contractor not asking for a modification of his guaranty. The owner, it was held, did not waive his right to insist upon the guaranty by his accepting a written guaranty of the subcontractor made to the contractor, or because the contractor refused to guarantee the plant after the house was finished.—Baylies vs. Bent, 185 Ill App., 437.

Some years ago the heating engineers' society discussed the subject in connection with the following topic that was placed on the programme: "Should the guarantee of efficiency be assumed by the heating engineer who designs the apparatus, or by the heating contractor, who installs it?" The ground was taken and generally endorsed by the speakers that if the engineer is not capable of laying out work to produce results he should not throw responsibility of his failure on the contractor. One speaker, however, called attention to the point that it was not always for the engineer to guarantee results. He instanced a case where a cerificate was issued even though it was known that a certain part of the building was not heated satisfactorily. It appeared, in that case, that the construction had been changed to put in swinging windows, swinging out, and these windows were operated by a series of chains. Owing to their construction 80 per cent. of the windows were open ¾ of an inch and they could not be closed.

The same speaker said he knew of cases where the courts have ruled that the contractor cannot be required to guarantee results to be obtained from plans and specifications furnished him. One was in connection with the construction of a steel bridge which should stand a test of so many tons per square foot and show a deflection of not more than so many inches. The bridge was constructed according to the plans and under the supervision of the county's engineer. The county rejected the bridge. The contractor took the matter into court and the court ruled, and was sustained by the Court of Appeals, that the contractor should not be required to guarantee the figures of the engineer.

The same thing happened in connection with the construction of the basement in one of the New York public schools, where there was inserted a guarantee in the specifications in the matter of making the basement water-tight. The requirements specified the thickness and foundation of the walls, that they should be waterproof, the method of doing it, etc. The cellar leaked like a sieve and the owners refused to pay for it. They went to court and, finally, to the Court of Appeals, and it was decided that if the owners employed a competent engineer, the contractor should not assume the responsibility.

C. B. J. Snyder, architect of the New York City Department of Education, and at that time president of the heating engineers' society, corroborated the foregoing by stating:

"The point under discussion has been carried into the courts of every State in the Union. One of the most famous decisions is that in reference to the 54th Street Court House in New York. One of the provisions of the contract was that the cellar was to be built in a particular manner, which was clearly specified, and, further, was also to be guaranteed water-tight. The contractor erected the building according to specifications, but the cellar was not water-tight. The court decided that the contractor could not be held both to build according to specifications and also to guarantee results.

"In order to cover this point, the corporation counsel of New York City has requested the heads of departments to insert in specifications a clause that if the contractor is not satisfied that the requirements of the specifications will result in making the guarantee possible, then he shall submit with his bid a brief statement of such changes as he desires to have made therein that will enable him to give the guarantee required."

The fact is that if a contractor accepts any layout and bases his contract on the plans, giving a guarantee, it makes very little difference who drew the plans, for he can be held for them. But if his contract is simply to heat the house to a certain temperature, without specific reference to any plans, he can still be held for it, but he cannot be obliged to carry them out, except in so far as may be specifically stated in the contract.

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Cleveland to Hold Building Show.

What is described as the first American complete building show will be held in Cleveland, O., February 16 to 26, 1916, under the direction of the Cleveland Chapter, A. I. A., in co-operation with the Cleveland Chamber of Commerce, Art Association, Builders' Exchange and other civic bodies. One of the features of the show will be an architectural competition for a workingman's home to cost not more than $3,000 complete, exclusive of land and embellishments. There are seven prizes, the first being $200. The contest is open to all materials. The rules of the competition call for six rooms, with basement under entire house. All drawings must be in by February 1. Instructions regarding the contest may be obtained by applying to the Complete Building Show Co., 356 Leader-News Building, Cleveland.

NEW DEVICES

H-and-C Hot Blast Radiator.

The accompanying illustrations show the construction of the new H-and-C hot blast radiator, which has recently been placed on the market by the Hart & Crouse Co., Utica, N. Y. This apparatus is the invention of William M. Kingsbury, formerly engineer for the Cleveland (Ohio) Board of Education. The H-and-C is a sectional base radiator. The base, which is of cast-iron, as are also the radiator sections, has a vertical longitudinal partition which divides it into a supply side and a return side. This construction avoids the difficulty sometimes experienced with pipe blast coils, when the base was made too long and the heating surface in the pipes too great for the cross section of the supply side, in that the high velocity of the steam is entering the base backed up by the water in front of it, thus preventing the water from flowing back to the drip pocket provided, and resulting in a part of the heating pipes being sealed off with water.

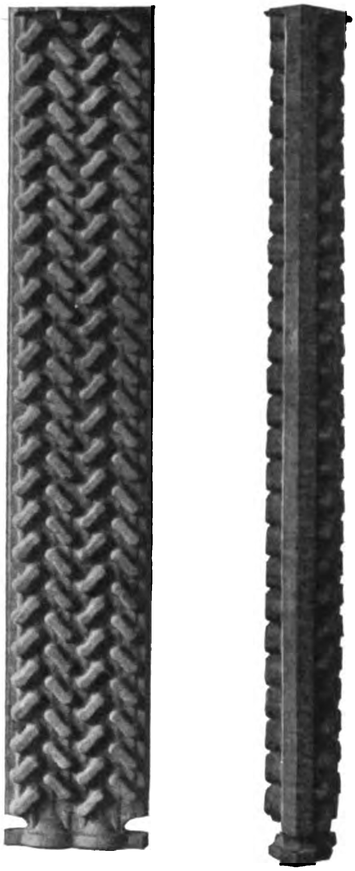
This difficulty has been overcome in the H-and-C radiator by casting a horizontal partition the width of the supply side of the base near the bottom, the end furthest from the supply opening being cut off within 1½-in. of the end of the base. This provides a space for the water to fall over into the lower drip chamber and permits it to flow back to the drip opening below the supply connection, without coming in contact with the incoming steam.

The radiator section is made with a vertical transverse partition corresponding with the partition in the base, which ends within a couple of inches of the top, leaving a means of communication between the two sides of the section near the top.

The steam enters from one side of the base, rising on the corresponding side of the section, and passes over the top of the partition, dropping down on the return side, compelling a complete circulation of the steam and perfect venting.

The entire construction is such as to permit the use of high steam pressures.

The sections are connected to the base by push nipples and tightened with bolts. The top of each section is made with a flat flange so that when a number of them are assembled in a row, they form a natural platform on which to set another base, and make the radiator two or more tiers high.



Face View Edge View

H-AND-C RADIATOR SECTION

Emphasis is laid on the ease and simplicity with which these blast radiators may be assembled, the radiator being made up into stacks with single sections having no screwed or gasket joints. Each section is mounted on a base independently .

In a catalogue just issued, carefully compiled tables are included covering tappings, heating surface, net air space, lengths, widths, centers and tiering.

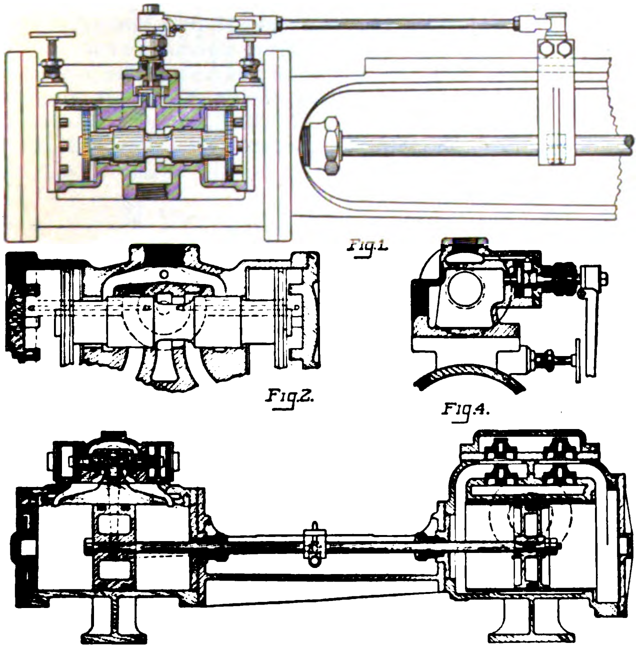
A New Steam Pump.

A steam pump with a new type of valve gear, embodying unique features, has recently been placed on the market by the American Steam Pump Co., Battle Creek, Mich. It is known as the American-Marsh, this name being chosen in order to identify it with this company's line of American and Marsh Pumps. As will be noted from the accompanying illustration, this new pump has a steam valve which is mechanically actuated and also self-governing. The fact that it is mechanically actuated is designed to insure positive action at all times, while the self-governing device allows only enough steam to enter the pump to do the required work. This feature is intended to reduce the steam consumption to a minimum.

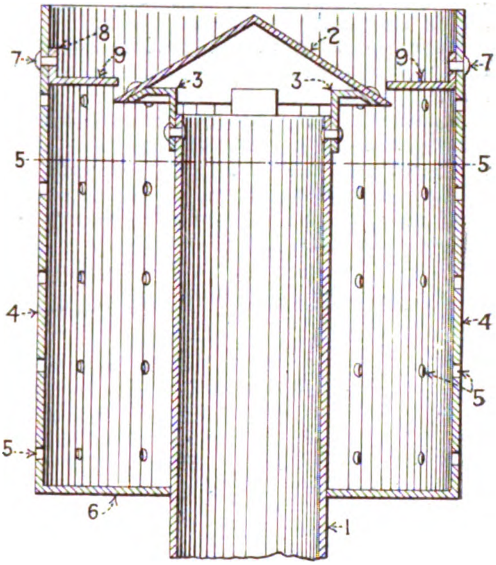
The construction of the pump is comparatively simple. The steam valve is of the valanced piston type, equipped with exansion rings, while the auxiliary valve is of the semi-rotative disc type which wears to a perfect seat. There are no slide valves and no loose links or tappets in the valve gear. In action it is claimed to be quiet.

Because of the ingeniously-constructed valve gear, it is claimed that the American-Marsh pump cannot hang up, even under the most severe conditions and even if the suction line is broken the pump will not race. The length of the stroke is regulated by two adjusting screws located at the fulcrum of the lever arm.

Because of their smooth action, American-Marsh pumps are especially adapted for use as vacuum pumps on heating systems and the manufacturers have recently issued a bulletin known as "No. 24," illustrating and describing this new type of pump.



SECTIONAL VIEWS OF THE "AMERICAN-MARSH" STEAM PUMP.



ASHORN VENTILATOR AND SPARK ARRESTER.

A Combined Ventilator and Spark Arrester.

A ventilating cowl, so designed that it serves at the same time as a spark arrester, is an interesting device that has just been patented by I. Ashorn, of New Ulm, Texas. It is listed as patent No. 1,162,205, issued March 30, 1915, and as patent No. 163,846 for Canada, issued July 20, 1915.

As will be noted from the illustration, smoke, air and sparks passing up through the flue will strike the cap 2, the smoke and air being deflected thereby and caused to pass out under the lower edge of said cap, when it will again rise and pass out between the cap and ring 7 into the atmosphere.

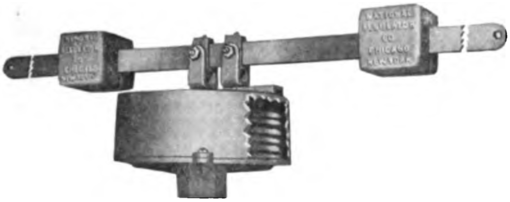
By its design, the cowl is intended to be not only a ventilator, preventing the smoking of any stove or chimney, no matter what the direction of the wind may be, or whether the flue ends below or above the top of the roof, but one of the main functions of the cowl is its use as a spark arrester, as it has been found to positively arrest both sparks and burning soot which had passed through the flue upon which the cowl is placed. It is stated that two-thirds of all fires originate on wooden buildings by sparks or burning soot falling on roofs.

Either or both of the patents on this cowl will be sold to the highest bidder by March 1, 1916.

A number of the Ashorn ventilators and spark arresters are already in use. The weight of each cowl is 5 lbs. It is made of galvanized iron and sells at $2.60, parcel post paid.

Use of Metaphram As a Damper Regulator.

The availability of the "Metaphram" valve for use in connection with a damper regulator, has led the manufacturers of this device, the National Regulator Co., of Chicago, to develop a new line of damper regulators in which the "Metaphram" is the distinguishing feature. When assembled, the "Metaphram," which is composed of a plurality of separable, collapsible corrugated metal disks connected by threaded studs, collapses of its own inertia, and is so constructed that when inflated, the disks are in contact with each other, utilizing all the initial power throughout their travel and exerting unusual strength. The advantage of the metal diaphragm for use in connection with diaphragm motors for actuating dampers, damper regulators, etc., will be seen when it is noticed that the metaphragm is made of metal throughout and has no rubber or other substance in its construction. They are designed for any shape of boiler, round or square, and operate on ounces between 0 and 5 lbs. pressure. A universal adjustment feature makes them applicable for pressure or vapor by changing the fulcrum position and shifting the weights and lever.



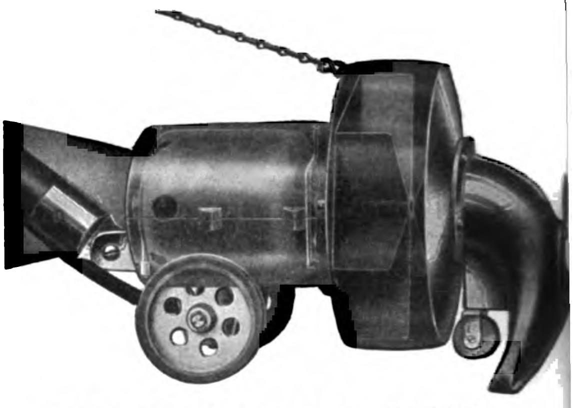
METAPHRAM DAMPER REGULATOR.

The manufacturers state, however, that the introduction of this valve does not indicate by any means the passing of the rubber diaphragms, its use being intended for conditions where the life of rubber has its limitations.

In further developments of this device the manufacturers announce that they are now making a "Metaphragm" boiler regulator of hot and cold water, milk pasteurizers and other commercial control.

The Magic Vacuum Cleaner.

An interesting type of portable vacuum cleaner is manufactured by the Innovation Electric Co., Inc., 585-589 Hudson Street, New York. The accompanying illustration shows the construction of this cleaner, which is claimed to be unusually efficient. It comprises a horizontal mounted motor and a 6-in. turbine fan enclosed in an aluminum base. It will operate on either direct or alternating current, 100 to 125 volts and 25 to 70 cycles. The weight of the apparatus is 12 lbs., height 7½ in., length 10½ in. and width of nozzle 12 in. The cleaner is supported on three wheels which contribute to its ease in running. The manufacturers emphasize the hand control of the nozzle by automatic catch as, with this arrangement, the nozzle can be raised from the floor without lifting the cleaner bodily.



CONSTRUCTION OF MAGIC VACUUM CLEANER.

REVERSIBLE NOZZLE BRUSH

This brush may be turned out of the way, when the cleaner will remove deep-seated dirt.

A push button switch is located in the pistol grip handle. It is stated that the Magic is the only cleaner having double dust bags.

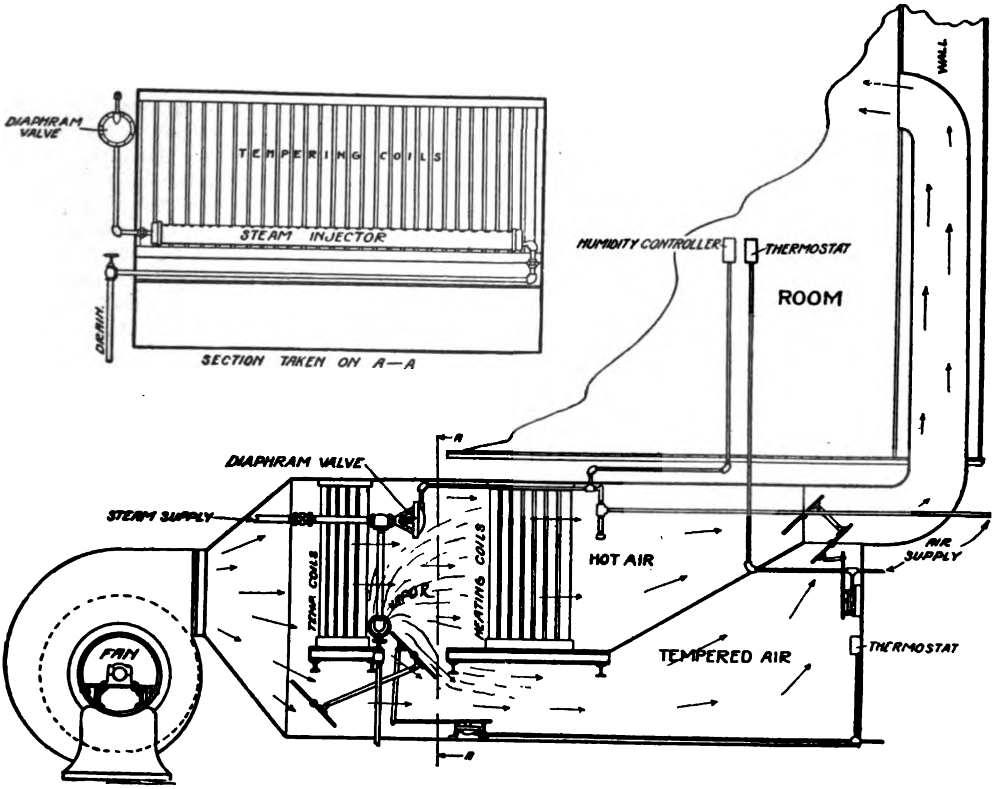
The company also manufactures the Liberty Cleaner, which has the exclusive feature of a reversible nozzle brush which may be turned out of the way when the cleaner is removing deep-seated dirt. This is also a portable cleaner.

Trade Literature.

Establishing and Maintaining Boiler Room Economy is the title of a paper presented before the Ohio Society of Mechanical, Electrical and Steam Engineers by George H. Gibson, developing the thesis that the most important requisites to further improvements in boiler room economy are means of recording boiler performance; that is, of determining the number of pounds of water evaporated per pound of coal. This pamphlet is being distributed by the Harrison Safety Boiler Works, 3189 No. 17th street, Philadelphia, Pa.

Economy Pumping Machinery, including Economy automatic condensation pumps and receivers, direct-acting vacuum pumps for heating systems, centrifugal pumps for various services, sewage ejectors, bilge pumps, etc., is the subject of a carefully prepared catalogue issued by the Economy Pumping Machinery Co., Chicago, Ill. The entire line is backed by the company's guarantee. The description of each pump is accompanied by a suggestive specification, together with all the necessary data for figuring the sizes required and similar matters. The Economy standard automatic condensation pump and receiver is one of the company's most interesting products, being designed to take the place of a receiving tank and a boiler feed pump. Each unit consists of an expansion tank, a centrifugal pump and an automatic switch and electric motor. This apparatus is made in three sizes, for draining 10,000 sq. ft. of direct radiation, for draining 45,000 sq. ft., and the third size built to meet practically any condition. Size 6 x 9 in. (standard). Pp. 83.

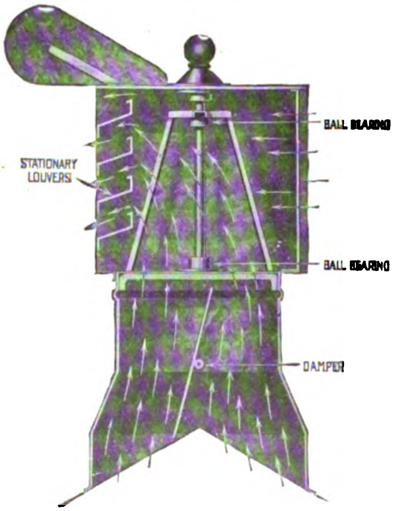
Automatic Temperature Regulators, comprising the product of the National Regulator Co., Chicago, Ill., are described in an impressive catalogue showing the extent of the company's line of instruments for automatically controlling hot air, steam or hot water heating apparatus, together with specially-designed apparatus for the automatic control of hot water tanks, ovens, etc. Some idea of the extensive use of National regulators may be gained by the illustrations of representative buildings throughout the country in which National apparatus has been installed, controlling both direct and indirect heating and ventilating systems. These illustrations take up 46 pages of the catalogue and range from the People's Gas Building, in Chicago, to residences, churches and private residences in various cities. Size 9 x 6 in. (bound in separate sheets).



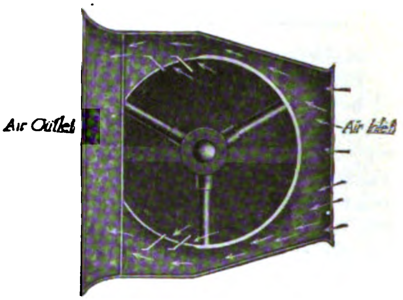
TYPICAL INSTALLATION OF NATIONAL TEMPERATURE REGULATING APPARATUS IN CHICAGO PUBLIC SCHOOLS

The Commercial Value of Fresh Air, demonstrating the beneficial effects of properly conditioned air upon the productive capacity of workers, is the title of a recent publication of the American Blower Co., Detroit, Mich., featuring the Sirocco air conditioning system. Many interesting quotations are included from ventilation authorities showing the practical value of clean, as well as humidified air. This is followed by "The History of 'Sirocco' Washed Air," in which is traced the development of the Sirocco apparatus from the McCreery air washers. Credit is given to Joseph McCreery as being the first patentee (1897) of an all metal air cleanser. The latter part of the catalogue is devoted to the requirements of air purification and the variouse types of Sirocco purifiers are here taken up in detail. Size 8½ x 11 in. (standard). Punched for binding. Pp. 44.

Burt Revolving Ball Bearing Ventilators are featured in newly-issued circulars sent out by the Burt Mfg. Co., Akron, O. In this novel design, advantage is not only taken of the air currents that pass over the top and sides of the ventilator, but provision is made to allow the air to pass directly through the ventilator, thereby creating a partial vacuum in the air shaft and increasing the ventilator's pulling power. This same construction also has a tendency to hold the ventilator steady with the wind, thus overcoming the whirling motion. It is equipped with two sets of ball bearings made from the same gauge of iron as that used in the company's sliding sleeve ventilator. It is made in 15 sizes, ranging from 12 in. diameter of neck to 72 in.



BURT BALL-BEARING REVOLVING VENTILATOR

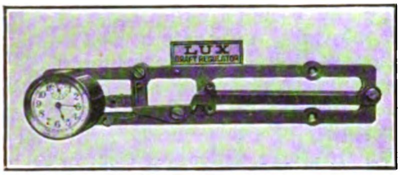


COURSE OF AIR THROUGH BURT BALL-BEARING VENTILATOR

Carrier Engineering Corporation, New York, "the organization that developed air conditioning," is the title of a timely booklet in which air conditioning is discussed in general, showing the part the Carrier organization has had in its development. The illustrations include portraits of Willis H. Carrier, president and chief engineer; J. I. Lyle, treasurer and general manager; E. T. Murphy, secretary and Philadelphia manager; E. T. Lyle, Boston manager; Alfred E. Stacey, Jr., western manager; L. L. Lewis, designing engineer, and H. P. Heckel, superintendent of construction. An idea of the various industries which have been served by this organization is shown by a partial list of the company's clients, which is included in the booklet. Size 4¼ x 7 in. Pp. 16.

Herbert Boilers for Steam and Hot Water, including the Herbert patent smoke-consuming boilers, garbage burners, heaters and tanks, are presented in a new catalogue for 1916, issued by the Herbert Boiler Co., Chicago, Ill. The Herbert down-draft principle of combustion is explained in detail. Special attention is called to the liberal room provided in this boiler for the expansion of the gases after leaving the firebox. The arrangement of the heating surface is also emphasized and the claim is made that the Herbert is the quickest steaming boiler on the market. The catalogue also shows the Herbert down-draft detachable firebox for tubular boilers, which, it is stated, may be applied to any standard horizontal tubular boiler. Other products of the company included in the catalogue are the Chicago down-draft smokeless boiler for buildings with shallow basements, the Herbert Junior all-steel boilers and Herbert garbage burning water heaters. Size 9¼ x 6 in. Pp. 68.

Lux Draft Regulator, designed to operate in connection wth any type of heater, is described in a circular issued by the Lux Mfg. Co., Washington, D. C. The company calls attention to the strong construction of this damper regulator, which is made of cast-iron, while the clock used is hinged to the frame, thus preventing its falling when winding. Attenton is called to the fact that this device is a draft opener and not a heat controller and is especially useful in opening the drafts at a predetermined time in the early morning.



LUX DRAFT REGULATOR

Steam Specialties, devoted to the product of the Steam Appliance Co., Milwaukee, Wis., are treated in a handy catalogue received from that company. The company's products include the Triumph line of oil separators, the Victor steam separators, Triumph exhaust head, Peters improved Corliss valve steam traps and grease traps; also the Peters water line governors, Henry steam flue cleaners and White's improved hollow base grate bars. The catalogue includes a long list of satisfied users. Size 5½ x 8 in. Pp. 78.

Mueller Record for Christmas, 1915, being the holiday number of the Mueller Record, published by the H. Mueller Mfg. Co., Decatur, Ill., is a unique number in which the Christmas spirit is given full expression. Interspersed with company matters are such classics as "The Moonbeam's Story," by Eugene Field; "Is There a Santa Claus," by Frank P. Church; "History and Legends of Christmas;" and "Old Scrooge and Christmas," by Charles Dickens. A double page is devoted to the pictures of twenty men who have completed twenty years of faithful service with the Mueller Company and who received a gift of $500 each as a reward.

Golden-Anderson Steam and Water Specialties are brought to the attention of the trade in a catalogue comprising the full line of the Golden-Anderson Valve Specialty Co., Chicago, Ill. Among the products featured is the Golden-Anderson automatic cushioned valves. The double "Corliss dashpot" method of cushioning these valves is employed, occupying the full area of the upper portion of the body, insuring a positive cushion in the opening and closing of the valves and alignment with the seat at all times, regardless of position. The catalogue is well arranged and shows the interior construction of each device. Size 6 x 9 in. (standard). Pp. 140.

Pierce Fitter's Book, published by the Pierce, Butler & Pierce Mfg. Corporation, whose headquarters are now in New York City, at 437 East 162d St., has been sent out to the trade, superseding the previous editions of this manual. The company's well-known line of Pierce American, Down Draft, Spence, and Touraine boilers, as well as its various types and styles of radiators, are listed, with all necessary details, also the company's water boilers for domestic use, fire-box boilers and garbage burners. Size 3⅞ in. x 6¾ in. Pp. 262.

Lagonda Cut-Off Valves, made by the Lagonda Mfg. Co., Springfield, O., are the subject of a new 24-page bulletin devoted to the company's line of triple-acting, automatic cut-off valves. These include the standard angle type and straight-way valve, the low, squat body valve for low headroom and the horizontal valve. Size 7½ in. x 10 in.

Minneapolis Duplex Thermostat, equipped with an 8-day automatic time adjustment (Model 55), with two actions each 24 hrs., is a recent product of the Minneapolis Heat Regulator Co., Minneapolis, Minn. The thermostat mechanism is so arranged that at night, automatically, the thermostat pointer is moved back to the night temperature, and again in the morning, at the predetermined hour, is moved forward to the day temperature. This action is performed independently of the clock. The thermostat pointer can also be moved entirely independent of the clock mechanism and its operation by hand does not affect its automatic operation. That is, the clock is never disengaged and is in control at all times.

NEW MODEL OF MINNEAPOLIS DUPLEX THERMOSTAT.

Overshadowing Supremacy is the title of a recent circular issued by the National Tube Co., Pittsburgh, Pa., calling attention to its award of the grand prize by the Panama-Pacific International Exposition, for its display, and explaining the distinctions between the grand prize and the other awards, such as medal of honor, gold medal, silver medal and bronze medal. For each class there is but one grand prize, so that only one exhibit of tubular and allied products could secure this distinction.

Three New Municipal Heating Plants Built During 1915.

Reports of district heating activities during the year show that three new municipal heating plants were built in 1915. One of these plants is located at Alexandria, Minn., and was built by F. A. Blakeslee & Sons, Minneapolis. The other two are in Springfield, Minn., and Worthington, Minn., built by J. E. Robb, Wadena, Minn. The engineer for all three installations was L. A. Larsen, St. Paul, Minn. In each case the fittings and meters installed were those of the Central Station Steam Company make. The pipe covering for the Alexandria and Springfield installations were of the H. W. Johns-Manville Company make, while in Worthington the covering of the Milwaukee Conduit & Insulation Company was installed.

Organization of Batterman-Truitt Co.

A new firm of specialists in heating, ventilating, exhaust and drying systems has been formed in Chicago under the name of the Batterman-Truitt Co., with offices at 32 West Washington Street. The firm will handle the Bicalky Fan Company's line of fans, blowers, exhausters and other apparatus within the central and western states. The principals are F. W. Batterman, formerly Chicago representative, who is president of the new concern; and J. E. Truitt, formerly Chicago sales manager for the Ilg Electric Ventilating Co., who is secretary and treasurer. The new company states that it will carry a complete stock of all the standard sizes of fans in Chicago territory, which will permit prompt shipments at all times.

F. W. Ballard & Co., engineers, Cleveland, O., is the title of a new engineering firm with offices in the Swetland Building. Mr. Ballard, the head of the firm, was until recently light and heat commissioner of Cleveland, and had direct supervision of the municipally-owned light and heating system which is operated in that city. The new firm will specialize in the building and operation of municipal electric light and power plants.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK FEBRUARY, 1916

The Principle of Bernoulli and its Relation to Heating and Ventilating of a Building

By S. R. WILLIAMS.

Let us suppose that water is flowing through a water main from a standpipe whose head is maintained at a fixed value. The water as it flows through the pipe is said to have a steady state of flow. The same state could also be said to exist if at some point in the pipe a constriction occurred. When in a fluid, either a liquid or a gas, we have a steady state of flow, the principle of Bernoulli states that the total energy per unit volume at one point in the stream must be the same as at some other point. In the case of water flowing through a pipe with a constriction in it we know that if the pipe does not have some branch opening or leak in it that the quantity of water which flows past one section of the pipe will be the same as at some other section.

This means that the velocity of flow in the pipe at a point of contraction must be greater than at some other point or that the kinetic energy is greater at a point of constriction than elsewhere. If this be true then from the law of the conservation of energy the potential energy must be smaller at a constriction than elsewhere in the pipe.

The expression for the kinetic energy of a unit volume of water in motion, of mass m and velocity v, is $\frac{1}{2}mv^2$, while for the potential energy per unit volume it may be shown that it is equivalent to the pressure, p, under which the liquid finds itself. Bernoulli's principle is another way of stating the law of conservation of energy; viz., that the sum of the potential and kinetic energies of a unit volume of a fluid at one point in a steady flow must be equal to the sum of these two energies for a unit volume at some other point.

We may express this condition by an equation thus:

$$p_1 + \frac{1}{2}mv_1 = p_2 + \frac{1}{2}mv_2 \quad \ldots\ldots\ldots\ldots (1)$$

where the subscripts indicate two different points, 1 and 2, in the steady state of flow. Applying this equation to the water pipe with a constriction in it, let 2, Fig. 1, represent a point of contraction in the pipe and 1 any other point where the pipe is of regular size. It has just been pointed out that v_2 must be greater than v_1, and since the mass is constant, p_2 must be smaller than p_1.

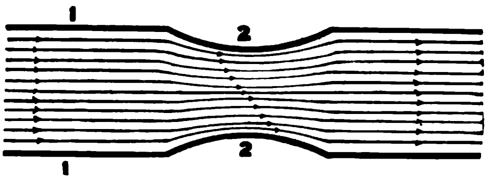


FIG. 1.—SHOWING THE CONVERGENCE OF STREAM-LINES OF FLOW IN A PIPE WHICH HAS A CONSTRICTION.

PRINCIPLE HOLDS FOR EITHER LIQUID OR GAS.

If equation (1) is to hold; i.e., at a point of contraction in a water pipe the pressure is less than at some other point.

This line of reasoning holds for either a liquid or a gas and the principle has a very wide application.

This difference in pressure for two points such as 2 and 1 in Fig. 1 is made use of in the Venturi water and gas meters. A pipe, A-B, Fig. 2, has a contraction drawn in it and at points 2 and 1 in this pipe, side tubes are introduced as shown in the illustration, to which a U tube is attached. If a quantity of some liquid is placed in the U tube and gas allowed to flow through the pipe A-B, then the liquid in the U tube will stand in the arm attached at the point 2 to a greater height than in the other arm and this difference, h, in height is a measure of the quantity of gas flowing through A-B.

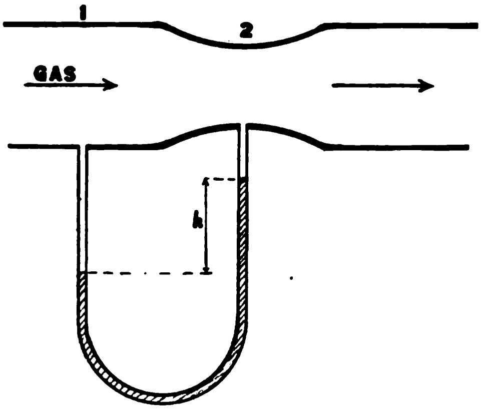


FIG. 2.—ILLUSTRATING THE PRINCIPLE OF THE VENTURI METER.

PRINCIPLE ILLUSTRATED BY ACTION OF BOATS IN RUNNING WATER.

Equation (1), which is a short hand statement of Bernoulli's principle, may be illustrated in another way. Picture, as shown in Fig. 3, two boats anchored rather near each other in mid-stream. The water, as it flows past the two boats, encounters what is practically a contraction of the stream-lines of flow and since, as has been shown, the pressure is least where the velocity is greatest there will be a difference in pressure exerted on the two sides of either boat which will be so directed as to cause the two boats to swing together. This may be very easily observed with two row boats. The same effect is present whether the boats are still and the water running or the two boats are drawn over still water.

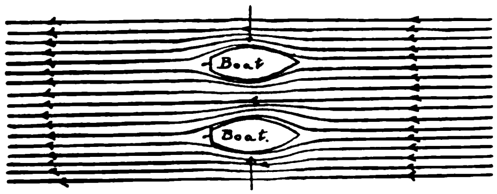


FIG. 3.—REPRESENTING THE FORCES TENDING TO SWING THE BOATS TOGETHER.

EFFECT OF WIND BLOWING PAST HOUSES.

In a similar way we may think of two houses past which the wind is blowing. See Fig. 4. The stream-lines of flow converge between the two houses and there is, by the principle of Bernoulli, a tendency for the two houses to move toward each other. Inasmuch as the houses are fixed, no such result occurs, but the air in the houses has this tendency and we have the continuous phenomenon of the houses being exhausted in just the way an aspirator works. This means that not only, due to the pressure of the wind on the windward side of the house, is the air inside of the house being driven out on the other sides, but the air is also being pulled out on the sides of the house past which the air is flowing.

DEMONSTRATION WITH SHEET OF PAPER.

This may be illustrated by the following simple demonstration. Hold a long sheet of writing paper by the corners of one end and allow the other end to hang down. If one blows directly over the top of the sheet at the end which is held as shown in Fig. 5, the free end will be

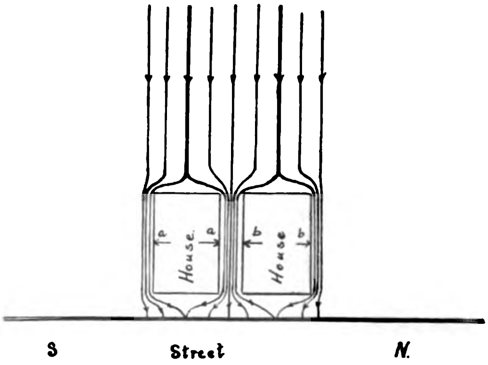


FIG. 4.—THE ARROWS a AND b INDICATE DIRECTIONS IN WHICH AIR IS DRAWN FROM HOUSE AS THE WIND BLOWS PAST.

lifted, due to the difference in pressure created according to the theorem of Bernoulli. In just the same way the side of a house tends to come out when the wind blows along it, but since it is rigid, the air inside comes out through every accessible crack and opening. This means a forced ventilation which is not altogether desirable when a cold wind is blowing about the house.

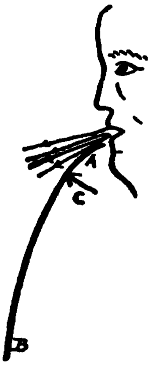


FIG. 5.—AIR BLOWN OVER A SHEET OF PAPER WILL PRODUCE DIFFERENCES IN PRESSURE WHICH WILL HOLD PAPER OUT HORIZONTAL FROM THE LIPS.

A HEATING SYSTEM THAT WORKED BACKWARDS.

The writer lives in a region where the winds prevail from the southwest to such an extent that the trees have a decided lean toward the northeast. For four years he lived on the west side of town where the wind has full sweep at the houses, which were built along the west side of a north and south street (see Fig. 4) and the operation of Bernoulli's principle was very frequently noticed. For a house heated by steam or hot water a ventilation of this sort was not so bad, but in the house in which he lived there was a hot air furnace whose cold air inlet was on the south side of the house and close to the adjoining house. As the prevailing southwest winds swept down between the houses, the principle of Bernoulli operated to such an extent that the hot air furnace worked backwards. After a month of vain endeavor to heat the house on windy days the author discovered a group of English sparrows sitting in the cold air shaft and enjoying the heat as it poured out, which gave him the clue as to why the interior of the house did not warm up.

On looking up the matter more carefully it was found that those who install hot air furnaces in this locality have never taken this matter into consideration. Indeed they seem to prefer to put the cold air inlet where it will be the most ineffective and there are many complaints about the difficulties of keeping the houses warm when the inlet is thus installed. In the house just mentioned this difficulty was overcome by extending the cold air shaft with inlet to the west side of the house and putting in a large control damper.

These observations are written in the hope of calling the attention of those who install our heating and ventilating outfits to the very large influence this phenomenon of Bernoulli has upon the heating and ventilating of buildings.

Effect of Velocity and Humidity of Air on Heat Transmission through Building Materials

By J. A. Moyer, State College, Pennsylvania.

(*Read before the American Society of Refrigerating Engineers, Dec.* 8, 1915.)

The work of the Engineering Experiment Station of the Pennsylvania State College in regard to the transmission of heat through various building materials has been devoted to a study of the effects produced by varying velocities and humidity of air over the material tested. Data of this kind have long been needed for the satisfactory and accurate design of heating and refrigerating systems.

All of the tests reported in this paper were made in the thermal testing plant of the Pennsylvania State College, where every effort has been made, without sparing expense, to eliminate all possible difficulties, so that accurate data may be obtained. The calorimeter is roomy, so that large samples can be tested. The means are also available for measuring and varying the velocity of the air; and by the use of accurate and delicate platinum resistance thermometers located in the calorimeter room, at the inside and outside walls of the material being tested, as well as on the surfaces, and imbedded at various distances in the body of the material, it is believed very accurate determinations can be made.

ARRANGEMENT OF PLANT.

This plant consists of two separate brick buildings. One building is 50 ft. by 18 ft. and is used to house a complete 5-ton experimental refrigerating plant. The other building, which is really the thermal testing room, is 32 ft. by 32 ft. on the outside, and contains centrally located within its walls the calorimeter room, which is 17 ft. by 17 ft. This room is cooled to low temperatures by a number of rows of brine coils set up on three sides. Cold brine is supplied from the refrigerating plant in the adjacent building through 2-in. heavily insulated pipes. Each of the materials to be tested is made into a cubical box of approximately 65 sq. ft. of outside surface; and this box is then suspended in the calorimeter room for testing. An electric fan and an electric heating coil are placed inside the box for producing the required uniformly distributed temperature difference between the inside and the outside of the box. By this method tests can be made for a very great range of temperature differences. Absolutely constant and uniform temperatures can be maintained for an indefinite period of time, and the method of measuring the heat put into the box per unit of time is measured by accurately calibrated voltmeters and ammeters on both the coil and the fan circuits. Direct or "continuous" current is used. Twenty platinum resistance thermometers made by the Leeds & Northrup Company, of Philadelphia, according to special designs for this work, are available for measuring the temperature inside and outside the test-box, as well as in its walls. Cylindrical platinum coils are used for measuring temperatures in all places except on the surfaces of the material where thin platinum resistance disks less than 1/50 in. thick are firmly attached to the surface on their flat sides. Adopting the method proposed by the United States Bureau of Standards, the temperatures have been observed in each test of such materials as are obtainable in blocks of considerable thickness, like cork-board, in the following locations: (1) Two feet from the surface of the material tested, inside and outside; (2) 1 in. from the surface. inside and outside; (3) on the outside and inside surfaces by absolutely close contact; and (4) at every inch of thickness through the material, with thin, flat platinum resistance thermometers, which can be accurately located.

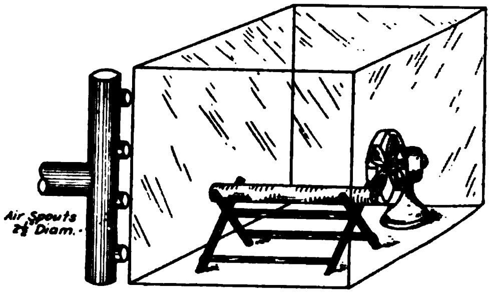


FIG. 1.—APPARATUS USED IN HEAT TRANSMISSION TESTS, FIRST SERIES.

Some of the most important data obtained during the last year will be presented briefly in this paper in the following order:

1. Variation of heat transmission through glass.
    (a) As affected by humidity.
    (b) As affected by velocity of air over surface,
    (c) As affected by various arrangements for directing the flowing air over the surface tested.
2. Variation of heat transmission through common red brick.
    (a) As affected by humidity.
    (b) As affected by velocity.
3. Variation of heat transmission through insulating brick, using high temperatures.

TESTS ON TRANSMISSION OF GLASS.

The series of tests studying the effect of heat transmission of glass was made upon a cubical box made of ¼-in. glass, diagrammatically shown in Figs. 1-3, and having a mean surface area of 66.67 sq.

ft. The box was placed in the calorimeter room and supported about 2 ft. from the floor.

The electrical heating coil, together with a small desk fan, was placed on the inside of the glass box, and thermometers placed 1 in. from the inside surface of the glass, as well as 1 in. from the outside. The temperature within was controlled by the electrical heating coil, and the air surrounding the glass box was maintained constant by the circulation of the brine in the pipes on the walls of the calorimeter room. The heat delivered to the box and transmitted through the material was measured in the form of electrical energy, and the unit transmission for still air circulated by the following formula:

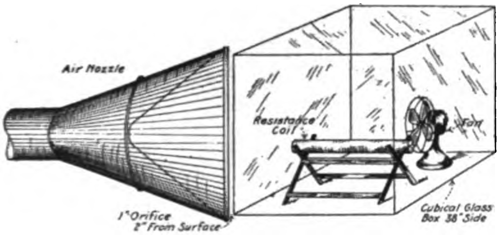


FIG. 2.—APPARATUS USED IN HEAT TRANSMISSION TESTS, SECOND SERIES.

$$H = \frac{(V_c \times A_c + V_f \times A_f)\ 3.41}{(t_1 - t_2)\ S} \qquad (1)$$

in which

H = unit transmission (B.T.U. per square foot, per hour. per degree difference of temperature measured 1 in. from the surface of the material tested, inside and outside the box.)

V_c = voltage of heating coil.

A_c = amperes of heating coil.

V_f = voltage of fan.

A_f = amperes of fan.

3.41 = constant in B.T.U. equivalent for one watt-hour.

t_1 = temperature of air in box, 1 in. from material tested.

t_2 = temperature of air surrounding box, 1 in. from material tested.

S = mean area of test box (66.67 sq. ft.).

Tests showing the variation of the heat transmissions with velocity were run similarly to those previously described, but with the exception that one large fan was used to blow air, which was directed by proper ducts, along one side of the box. This velocity ran from 150 to 1,000 ft. per minute and was regulated by dampers suitably located in the ducts. The velocity was measured by means of a carefully calibrated anemometer, averaging the readings for several points along the surface tested.

The heat transmission other than for still-air conditions was calculated as follows:

$$H_2 = \frac{(V_c \times A_c + V_f \times A_f) 3.41 - S_1 (t_1 - t_2) H_1}{(t_1 - t_2) S_2} \qquad (2)$$

H_1 = unit transmission of tested material under still-air conditions (B. T. U. per hour per square foot per degree difference in temperature measured 1 inch from inside and outside surfaces).

H_2 = unit transmission of material tested for velocity.

S_1 = area five sides of test box in still air (55.56 sq. ft.).

S_2 = area material tested (11.11 sq. ft.).

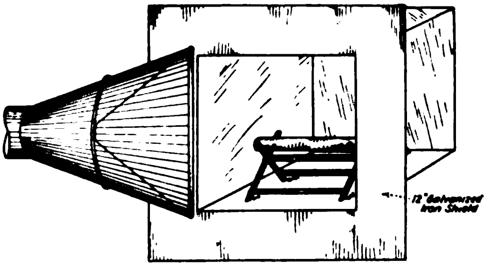


FIG. 3.—APPARATUS USED IN HEAT TRANSMISSION TESTS, THIRD SERIES.

V_c = voltage of coil.

A_c = amperes of coil.

V_f = voltage of fan.

A_f = amperes of fan.

3.41 = constant (B. T. U. equivalent of 1 watt-hour).

t_1 = temperature 1 in. from inside surface. (Average.)

t_2 = temperature 1 in. from outside surface.

It is to be noted in applying formulas for heat transmission with varying velocity that the value of H_1 or the heat transmitted under still-air conditions may have been determined under different conditions of humidity than that for the transmission under varying velocity conditions. It was then necessary, in order to apply this term, to find the effect of humidity on the heat transmission so that the still-air conditions may be corrected to the conditions of the test. The transmission under the given conditions of the test were then corrected to an assumed standard of 80 per cent for comparison.

The varying velocity in the first series of tests upon glass was arranged by terminating the duct from the fan into a small, circular tank or receiver, from which small spouts uniformly distribute the air over the surface tested. The arrangement of apparatus used in the first series of heat transmission tests is shown in Fig. 1 and the results in Table I.

The theoretical disadvantage of this system was due to the possibility of the air flowing over the surface in the form of a jet, and thus producing variable velocities.

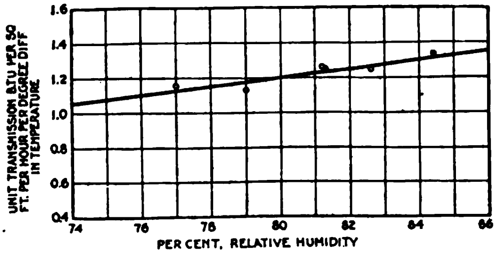


FIG. 4.—EFFECT OF MOISTURE IN AIR ON HEAT TRANSMISSION OF GLASS.

TABLE I. RESULTS OF TESTS SHOWING EFFECT OF AIR VELOCITY UPON THE TRANSMISSION OF HEAT THROUGH GLASS. GLASS CUBE EQUIPPED WITH AIR SPOUTS (Fig. 1).

Test No.	Air velocity ft. per minute	Humidity %	Unit trans. given conditions	Unit trans. corrected to 85% humidity
8	0	77	1.154	1.234
9	400	80	1.640	1.640
10	600	79	1.858	1.883
11	950	79	2.115	1.140

In the second series of tests on glass with varying velocities, the objection to the use of spouts was overcome by arranging the apparatus so that the air would be delivered over the surface in a thin sheet. This was accomplished by terminating the duct into a flattened cone or nozzle, as shown in Fig. 2. The results are given in Table II.

The arrangement of the apparatus used in the second series gave results that were very high as compared with the results as obtained from the first series. The discrepancy was thought to be due to the production of eddy currents over the surfaces having apparently still-air conditions. In the third series of tests this objection was eliminated by placing a galvanized iron shield 12 in. wide around the surface tested. The results of the tests are given in Table III and the apparatus is shown in Fig. 3.

TABLE II.—RESULTS OF TESTS SHOWING EFFECT OF AIR VELOCITY UPON THE TRANSMISSION OF HEAT THROUGH GLASS. GLASS CUBE EQUIPPED WITH AIR CONE, BUT WITHOUT SHIELD. (Fig. 2).

Test No.	Air velocity ft. per minute	Humidity %	Unit trans. given conditions	Unit trans corrected to 80% humidity
12	0	84.4	1.338	1.230
13	350	80.3	4.007	4.000
14	600	75.5	4.427	4.530
15	1,025	82.6	4.772	4.708
16	1,120	79.6	5.600	5.605

TABLE III—RESULTS OF TESTS SHOWING EFFECT OF AIR VELOCITY ON THE TRANSMISSION OF HEAT THROUGH GLASS. GLASS CUBE EQUIPPED WITH AIR CONE AND 12-IN. GALVANIZED IRON SHIELD. (Fig. 3.)

Test No.	Air velocity ft. per minute	Humidity %	Unit trans. given conditions	Unit trans corrected to 80% humidity
17	0	81.3	1.263	1.230
18	420	74.1	3.409	3.560
19	865	75.8	3.798	3.900
20	1,000	79.0	4.010	4.035
21	1,000	77.2	3.973	4.040
22	1,200	79.5	4.207	4.220

The results of the tests on the effect of humidity upon the transmission of heat through glass are given in Table IV and graphically shown in Fig. 4.

TABLE IV—RESULTS OF TESTS SHOWING EFFECT OF HUMIDITY UPON THE TRANSMISSION OF HEAT THROUGH GLASS. (Fig. 4.)

Test No.	Air Velocity, Ft. Per Min.	Humidity, %.	Unit Transmission.
1	0	77	1.154
2	0	79	1.129
3	0	81.2	1.260
4	0	81.3	1.255
5	0	82.6	1.256
6	0	84.3	1.288
7	0	84.4	1.338

The results of the tests given in Tables I, II, and III are reproduced graphically in Fig. 5.

TESTS ON THE TRANSMISSION OF COMMON RED BRICK.

The study of the transmission of heat through common red brick was performed with apparatus similar to that used in the study of the transmission of heat through glass. A brick cube was constructed of a single thickness of ordinary red building brick laid in approximately ¼-in. lime mortar. The general outside dimensions were 46 in. square, thus making the inside dimensions 38 in. square, as was the case of the glass cube. The heat was supplied to and transmitted through the brick cube, as well as temperature readings, etc., were obtained in the same manner as described for the test made on th glass box.

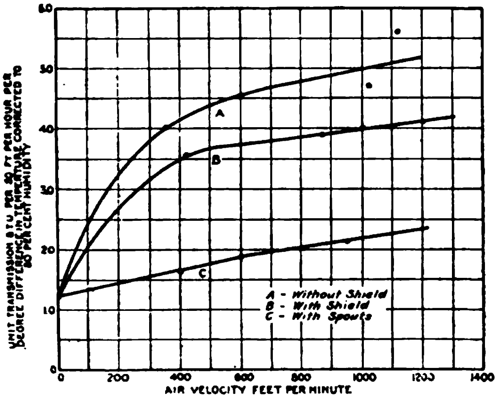


FIG. 5.—EFFECT OF AIR VELOCITY ON HEAT TRANSMISSION OF GLASS.

In the first series of tests the effect of humidity upon the transmission of heat was studied. This was accomplished under still-air conditions and calculated by formula (1), the results of which are shown in Table V.

In the second series the effect of varying the velocity was considered. In this series the apparatus used was identical to that used for glass in the second series of tests, or, in other words, by the use of an air cone or nozzle without a shield. The heat transmission was calculated by equation (2). Results of these tests are given in Table VI.

TABLE V—RESULTS OF TESTS SHOWING EFFECT OF HUMIDITY ON THE TRANSMISSION OF HEAT THROUGH COMMON RED BRICK. (Fig. 6.)

Test No.	Air velocity, ft. per minute	Humidity %	Unit transmission
23	0	81	.6645
24	0	83.5	.6986
25	0	83.9	.7094
26	0	84	.7035
27	0	86.5	.7287
28	0	88	.7617
29	0	89	.760
30	0	94	.7780

TABLE VI.—RESULTS OF TESTS SHOWING EFFECT OF AIR VELOCITY ON THE TRANSMISSION OF HEAT THROUGH COMMON RED BRICK. BRICK CUBE EQUIPPED WITH AN AIR CONE, BUT WITHOUT SHIELD. (Fig. 6.)

Test No.	Air velocity ft. per minute	Humidity %	Unit trans. given conditions	Unit trans. corrected to 80% humidity
31	0	84	.7035	.6635
32	210	83.8	1.157	.9350
33	230	90.5	1.081	.9700
34	450	91	1.190	1.075
35	660	91	1.223	1.110
36	660	89	1.251	1.160
37	765	90	1.272	1.155
38	850	91	1.280	1.177
39	1,050	91.2	1.348	1.230
40	1,100	93.8	1.400	1.250
41	1,530	89	1.420	1.330
42	1,530	88	1.436	1.355

Fig. 6 contains curves showing the effect of air velocity and humidity on the heat transmission of common red brick.

TESTS ON THE TRANSMISSION OF HEAT THROUGH INSULATING BRICK.

The tests upon the heat transmission of insulating brick were made to study the effect of the transmission of heat through this material under high temperature differences. The unit transmission for this material had never been accurately determined.

The apparatus used in testing the heat transmission of this material was identical with the apparatus used in the tests of common red brick, as previously described. A cube of insulating brick was constructed by a single layer of the bricks, the outside dimension of which were 46 in. square, thus making the inside dimension 38 in. square, as was the case of the glass cube. The heat supplied to the cube, as well as temperatures, etc., were measured as in other tests. All the tests were run under still-air conditions, the surfaces tested being subject only to the velocity created by natural circulation and the internal temperature maintained inside the cube was varied from 800° to 1,700° F. The results of these tests are shown graphically in Fig. 7.

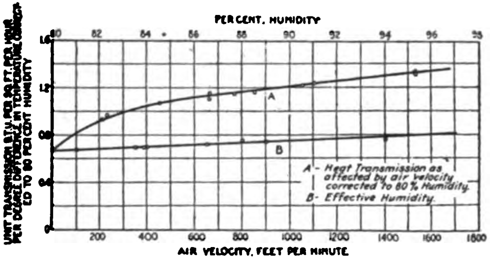


FIG. 6.—EFFECT OF AIR VELOCITY AND HUMIDITY ON HEAT TRANSMISSION OF COMMON RED BRICK.

CONCLUSION.

These data show that the transmission through glass and red brick is increased very materially with increase in humidity. Thus for glass the unit transmission was increased 0.25 B.T.U. by increasing the humidity from 74 to 84 per cent, which is equivalent to a change of 24 per cent in transmission for a variation of 10 per cent. in relative humidity. For red brick the unit transmission was increased 0.102 B.T.U. by increasing the relative humidity from 80 to 90 per cent., which is equivalent to a change of 15 per cent. for a variation of 10 per cent. in relative humidity.

The effect of velocity on the transmission of heat, as shown by the data, varies greatly, depending upon the arrangement for conducting the air over the surface tested. In the case of glass the unit transmission corrected to 80 per cent. humidity, and at 1,000 ft. per minute velocity has these values: 2.19 B.T.U. for a cube equipped with sprouts; 4.00 B.T.U. for cube equipped with air cone alone. These factors show very conclusively that in studying the effect of velocity upon the transmission of heat through a material, the arrangement if apparatus for protecting that portion of the material which is considered under still-air conditions is of the utmost importance.

It is true, the arrangement of the apparatus as used in the first series of velocity tests, or, in other words, equipping the glass cube with the air spouts, gave values which are low, due to the variable velocities produced by the jets, while, on the other hand, the failure to protect the surfaces not directly acted upon by the moving air gives too high results In all probability the results with the use of air cone and shield, or as shown in the second series of tests upon glass, give the best results. Assuming this to be true, it is interesting to note that in the case of glass the unit transmission when corrected to 80 per cent. humidity gave an increase of 2.78 B.T.U. for an increase of velocity from 0 to 1,000 ft. per minute, which is equivalent to an increase of 220 per cent. per 1,000 ft. per minute of air velocity.

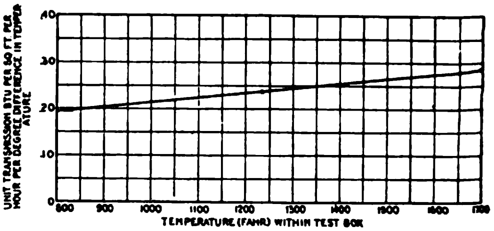


FIG. 7.—EFFECT OF TEMPERATURE ON HEAT TRANSMISSION THROUGH INSULATING BRICK.

The Engineering Experiment Station, in continuing the study of the effect on heat transmission with varying velocities of air by different arrangements of apparatus, is replacing the glass cube as used in the tests reported here by making five sides of the cube of cork board and the sixth of glass. It is thought that by this arrangement the effect of eddy currents upon the surfaces assumed to be in still air may be practically eliminated owing to the small unit transmission of cork.

The transmission of heat through common red brick was obtained by use of apparatus similar to that shown for glass in the second series of tests or the brick cube was equipped with air cone without shield. These results, judging from the effect of the arrangement as shown in the tests on glass, will be high. But the percentage of error introduced will be small, owing to the low value of the unit transmission of brick. The results of these tests on common red brick when corrected to 80 per cent. relative humidity show an increase in unit transmission of 0.56 B. T. U. for an increase of an air velocity from 0 to 1,000 ft. per minute, which is equivalent to an increase of 84 per cent. for an increase of 1,000 ft. per minute in velocity.

These results seem to indicate that in the calculations for the design of heating and refrigerating plants the old method in which an exposure factor is assumed to cover the effect of velocity should be revised.

The increase in heat transmission due to the same velocity is not the same for all materials, and that instead of the use of an assumed constant which is the same for all materials, new values should be obtained for each material. The effect of humidity is another factor which has heretofore been neglected, and, while under ordinary conditions, may not effect the transmissions in a practical sense, yet in installations when the humidity is high this increase in the transmission should not be overlooked.

In the test made upon insulating brick, while the number of tests were small, no definite conclusions can be drawn, but from the results obtained the unit transmission does not remain constant, and varies considerably with the temperature within the test box.

Heating a Chicago Office Building

By S. Morgan Bushnell.

(Read before the American Society of Heating and Ventilating Engineers, January 20, 1916.)

In the following description of the heating of a large office building, an attempt has been made to give a practical illustration of the heating requirements of a modern office building and to show in a general way the relation between theoretical calculations and the actual results under typical operating conditions.

The building under consideration is located at the northeast corner of Clark and Adams Streets, Chicago, is 181 ft. by 190 ft. in area, with a height of 260 ft., and above the fourth floor has a court 60 ft. by 120 ft.

The building was formerly occupied by the Continental & Commercial National Bank, but on the completion of their new structure at Adams and La Salle Streets, the bank moved out and the building has since been occupied by the Commonwealth Edison Company, the local company which supplies electricity throughout the city.

The building was formerly equipped with plunger hydraulic elevators which were operated in connection with a steam plant which also provided steam for heating and for driving the electric generators which provided light and power in the building. About two years ago the dynamos and engines were removed and the plunger hydraulic elevators were replaced by one-to-one traction type electric elevators. The building now purchases electricity from the Commonwealth Edison Company and steam from the Illinois Maintenance Company, according to the regular printed contracts of these companies. This change in the method of operation has resulted in a substantial saving in the annual operating costs of the building.

The consumption of electricity is high for a building of this size, due mainly to the fact that it is the headquarters of the Commonwealth Edison Company which uses light very lavishly both in its offices and in its show rooms on the first floor. The steam requirements are also high, due to the fact that steam is left on all night to accommodate some of the employees of the Edison Company, particularly the load despatcher's office.

In accordance with the policy of a number of large Chicago office buildings, the building management has made a contract on the meter basis with the Illinois Maintenance Company to supply steam from the boiler plant in the basement in accordance with their regular price schedules. An arrangement is also made with the Illinois Maintenance Company to supply labor to take care of the plumbing, radiation and electrical apparatus up through the building, also for the maintenance of the elevator system.

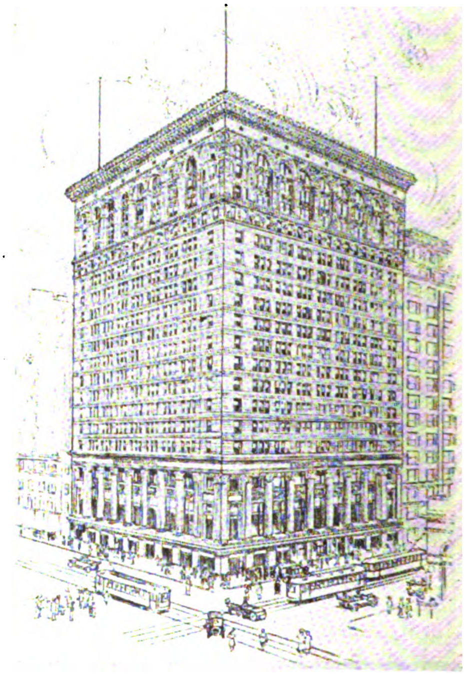
STEAM REQUIREMENTS FOR THE PAST YEAR.

Steam is used simply for heating and hot water service in the building and accordingly the summer requirements are comparatively small. During the past summer season, the weather was especially cool and steam was required for heating the building at times even in the summer months.

The steam is measured by St. John meters, and the following table shows the requirements during the past year beginning with December, 1914:

Months.	Lbs. of Steam.	Cost.
December, 1914...	9,358,000	$3,481.38
January, 1915.....	10,014,000	3,717.54
February, 1915...	7,815,000	2,925.90
March, 1915......	8,390,000	3,132.62
April, 1915.......	3,642,000	1,423.62
May, 1915........	3,356,000	1,320.66
June, 1915.......	897,000	430.79
July, 1915........	441,000	238.95
August, 1915.....	482,000	257.40
September, 1915..	794,000	389.07
October, 1915....	2,754,000	1,103.94
November, 1915...	5,121,000	1,956.06
Totals	53,064,000	$20,377.93

From the above it may be seen that the cost of steam service in the building amounts to about $20,400 per year, at an average price of a little over 38 cents per thousand pounds. This price is very low, due to the fact that the heating company does not have any investment in boilers or steam pipe lines, the steam generating plant being furnished by the building, while the heating company simply furnishes the labor and supplies to operate the plant. Judging from the steam that is used during the summer months, it is assumed that the steam requirements for hot water service approximate 500,000 lbs. per month. Deducting from the above total of 53,064,000 lbs. 6,000,000 lbs. for hot water, service makes the net heating requirements of the building, in round numbers, 47,000,000 lbs. of steam per year.



COMMONWEALTH EDISON BUILDING, CHICAGO.

COMPARISON BETWEEN THEORETICAL AND ACTUAL REQUIREMENTS.

It might be interesting to make a comparison between the theoretical steam requirements and the actual results. The building is a modern steel and terra cotta building, having an outside wall exposure of 149,192 sq. ft., glass surface of 85,558 sq. ft. and a roof surface of 27,190 sq. ft. The formula used by the heating company is:

$$T = \frac{S \times 0.2}{E}$$

in which

T = Number of tons of coal used per year.

S = The equivalent glass surface in square feet.

E = The factor of evaporation.

In order to find the equivalent exposure in square feet of glass surface, to the total glass area, add one-tenth of the net wall area, including the roof, allowing 10% additional for the north and west exposures. It has been found as a matter of experience that in this building an average evaporation of 5½ lbs. of steam per pound of coal is obtained. The equivalent glass exposure equals 107,031 sq. ft. Substituting these values in the heating formula $\frac{S \times 0.2}{E}$ gives $\frac{107{,}031 \times 0.2}{5\frac{1}{2}}$ or 3,892 tons of coal per year. Taking our evaporation of 5½ lbs. per pound of coal, each ton of coal would generate 11,000 lbs. of steam, therefore the theoretical heating requirements would be 3,892 × 11,000, or 43,812,000 lbs. of steam per heating season. This figure assumes that the building is equipped simply with direct radiation. In this particular building there is an equivalent heating surface in the indirect system for the basement and lower floors of 4,000 sq. ft., assuming that the indirect radiation will require double the amount of steam per square foot that the direct radiation requires. Taking one-half of 4,000 sq. ft. times 783 lbs. of steam per square foot per season, gives an additional 1,566,000 lbs. Adding this to the theoretical requirements in direct radiation, there is a total of 45,378,000 lbs. per year. As compared with the actual results or 47,000,000 lbs. during the past season, the consumption is a little over 3½% above the theoretical requirements. This may be explained partly by the fact that the temperature during June and September, 1915, was below the average, requiring steam for heating at certain times, and also by the conditions above stated, viz.: the unusual steam requirements at night.

The installed radiation in the building is about an equivalent of 60,000 sq. ft. of direct radiation. Dividing this into 47,000,000 lbs. of steam, we have a consumption of 783 lbs. of steam per season per square foot of radiation. This amount is a little higher than has been found customary in similar buildings in Chicago. This may be explained by the fact that the radiation installed is slightly under the customary required amount, viz.: 107,000 the equivalent glass surface $\times \frac{6}{10}$ equals 64,200 sq. ft.

ARRANGEMENT OF HEATING EQUIPMENT.

The accompanying diagram shows the general arrangement of the heating equipment in the building. It will be noted that the design is a one-pipe overhead or down-feed system and is operated with the Paul vacuum system, and the Johnson thermostatic type of heat regulation. The heating throughout the building is done by means of live steam, the steam being furnished from the boilers at a pressure of 90 lbs. and expanded through a 12-in. reducing valve into a tank at a pressure slightly above atmosphere, depending upon the temperature. As shown in the illustration, the steam for the upper floors is carried through an 18-in. riser to the roof, where distributing lines connect with branch risers leading to the basement return headers. The heating of the first floor is supplied by a separate pipe feeding from the expansion tank. There is also a separate supply leading to the heating coils of the indirect heating system. The Paul air valve lines are carried from the different radiators alongside the risers to the basement, where they enter a manifold connected with the suction of the vacuum pumps. The bottoms of the various risers are connected to basement return headers which carry the return waters of condensation back to the heaters, whence they are pumped back to the boilers.

The St. John meters are installed

where the main steam line leaves the boiler header and there are two 6-in. meters in multiple for the maximum load. Thus far one meter has been found sufficient, even in cold weather, and the valve to the other meter is closed. The system operates under average conditions with 18 in. of vacuum.

There are about 78 secondary steam risers, each riser having a diameter of 3 in. at the upper floors and 2 in. at the basement. The thermostats are placed at suitable points in the different rooms, it being the endeavor to locate them at points in the room where the average conditions of heat prevail. The radiators are all located at the windows, with a view to minimizing changes in radiation when partitions are removed.

The air pressure for the Johnson system is supplied by two 3-horsepower motors which consume about 27 kilowatt hours per day. The air pressure used is about 15 lbs. per square inch.

Inasmuch as some buildings provide the steam heating from a plant which also provides electric light and power, the itemized costs of central station electrical service in connection with the miscellaneous supplies required in the building are also given in order to show the relation between the different items and to make easier a comparison with other buildings.

FIGURES FOR ELECTRICAL CONSUMPTION.

The figures on the electrical consumption cover the same period as those given above for the steam consumption and are as follows:

	K. W. Hours
December, 1914	84,640
January, 1915	84,890
February, 1915	109,480
March, 1915	127,000
April, 1915	129,510
May, 1915	126,200
June, 1915	126,310
July, 1915	126,860
August, 1915	138,850
September, 1915	170,055
October, 1915	157,205
November, 1915	218,926
Total	1,599,946

The total consumption for the year for elevators was 390,610 K. W. hours; for miscellaneous power, 208,250 K. W. hours; for corridors and public lighting, 128,190 K. W. hours; for tenants, including the electricity used by the Edison Company, 872,896 K. W. hours. The rate earned by the building under the lighting company's wholesale schedules is less than 2c. per K. W. hour, making the total cost of electricity for 1,600,000 K. W. hours about $32,000.

Inasmuch as the largest tenant is the Edison Company, the building does not derive any profit from retailing electricity for a large portion of the space. If all the electricity used by tenants were sold by the building, as is the case in a number of other buildings, at an average of 5 or 6 cents per K. W. hour, the income from the tenants would more than pay for the entire cost of the electricity for the building. The comparatively low consumption of electricity during the first months of the year was due to the fact that several floors of the building were being remodeled for the use of the various departments of the Edison Company, which moved in during the year.

In addition to the cost for steam and electricity, the building pays the Illinois Maintenance Company approximately $4,000 per year for the care of fans, radiation, plumbing and elevators throughout the building. It also pays $3,300 per year for two electricians employed in the building. The building has the following expenses for supplies:

Electrical supplies	$474.00
Elevator supplies	1,038.00
Heating supplies	493.00

Summarizing the above, we have as follows:

Electricity	$32,000.00
Steam	20,377.93
Additional labor furnished by heating company	4,000.00
Electricians	3,300.00
Electrical supplies	474.00
Elevator supplies	1,038.00
Heating supplies	493.00
Total	$61,682.93

SAVING IN OPERATING COST.

In round numbers, the cost, therefore, of heating and furnishing the electrical requirements of this building which, as seen from the above, are unusually heavy, amounts to about $62,000 per year. Three years ago, the cost of operating the building from a private plant with hydraulic elevators, including fixed charges on the investment for dynamos and engines, was about $75,000, and the electrical requirements amounted to about 1,300,000 K.W. hours per year, low efficiency lamps being used at that time. Comparing the cost of steam, therefore, with the total cost of operating a complete plant, we see that the ratio of the heating cost to the total is about the same as one to three and one-half.

FIGURING BOILER HORSEPOWER RATIO.

In a paper read before the Society last September by Mr. James A. Donnelly, an interesting table was given for the transmission of that at various temperatures from cast-iron radiators. Where the steam temperature is 210° F., the transmission is given at 250 B.T.U. per hour per square foot of radiation. The ordinary heating season in Chicago is 243 days. The average period during which steam is on the radiators of an office building will run about 12 hours per day. If in this particular building we assume a little higher average,

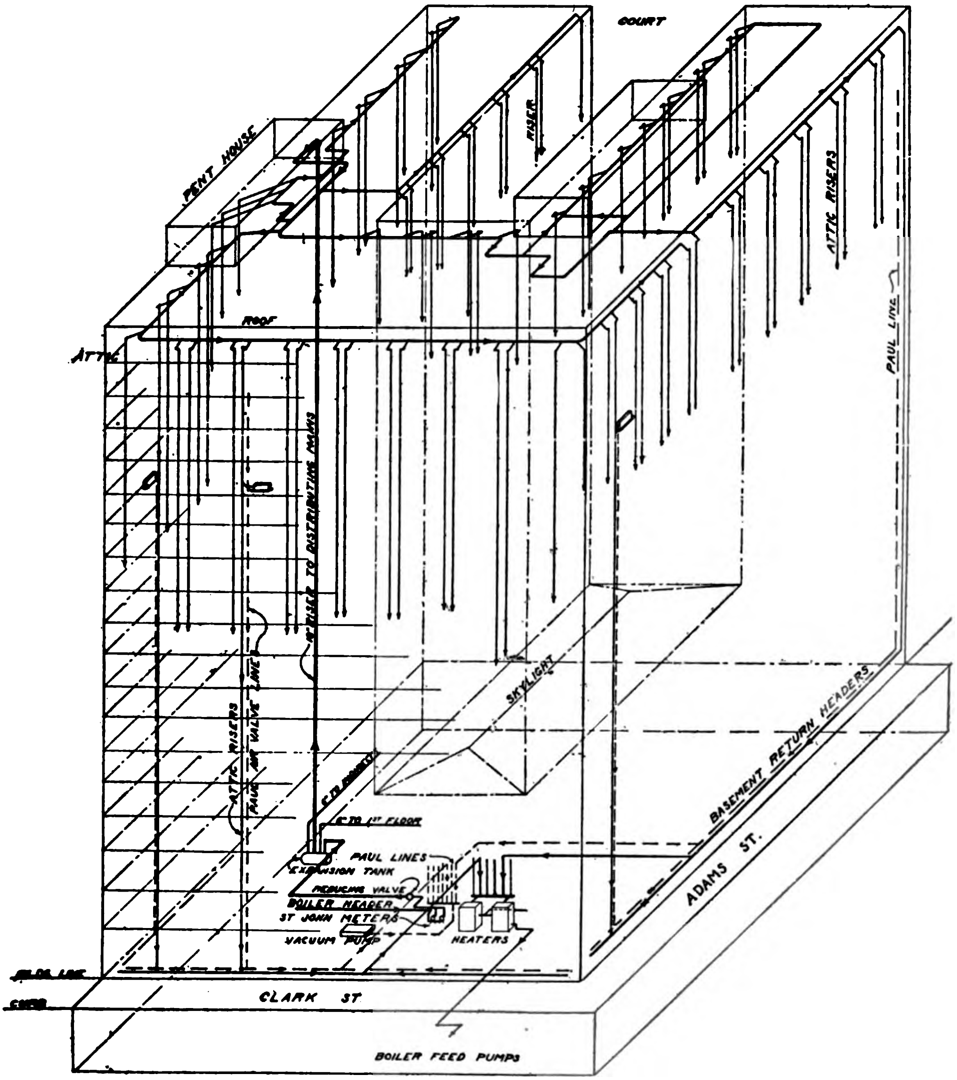


DIAGRAM OF HEATING EQUIPMENT IN COMMONWEALTH EDISON BUILDING, CHICAGO.

perhaps 13 hours per day, there will be 3,159 hours during the heating season. 250 B.T.U. per square foot per hour, times 3,159 hours, gives 790,000 B.T.U. per square foot of radiation. Assuming about 1,000 B.T.U. for each pound of steam gives 790 lbs. of steam per square foot of radiation. Multiplying this by the total of 60,000 sq. ft. gives 47,400,000 lbs. as the amount of steam which would be used during the season. This is a little higher than the actual consumption of steam in the radiators. The maximum steam consumption during the winter in any hour as shown by the meter charts was 17,800 lbs. per hour. This at 30 lbs. of steam per boiler horsepower would be the equivalent of approximately 600 horsepower. A comparison with the total square feet of radiation gives a ratio of one horsepower in boiler capacity used to each 100 sq. ft. of radiation.

CAN HEATING REQUIREMENTS BE DETERMINED FROM A SHORT TEST?

The question frequently arises as to whether it is possible by making a test on the heating requirements of a building during two or three days, to approximate the heating requirements during the entire heating season. About the middle of November, 1915, the daily mean temperature for about a week averaged between 38° and 40° F. If the heating season in Chicago is taken as beginning October 1 and ending May 31, or a period of 243 days, the average temperature during that time is 39° F. It would therefore be interesting to find out whether the consumption of steam during these days (which happened to have average temperatures for the season) corresponds. with the average for the heating season. Deducting the steam consumption during the four months of summer, there is an actual consumption for the heating season of 50,450,000 lbs. During this week in November, while the average temperature was about 39°, the meter showed about the same consumption each day, viz.: 210,000 lbs. Multiplying 210,000 lbs. by 243, the number of days in the heating season, gives a total of 51,030,000 lbs. This checks very closely with the actual consumption of 50,450,000 lbs., and would tend to indicate that where the temperature is approximately stationary for several days, a fair idea of the heating requirements for the season can be obtained from a short test. This probably would not prove true if the temperature should vary greatly from day to day, as there is a certain lag between the steam requirements of a building and the outside temperature.

In making estimates based on such tests, it, of course, should always be borne in mind that the steam requirements are not proportional to the variation in outside temperature, but to the difference in degrees between the indoor temperature and the outside temperature.

OPPORTUNITY FOR CHECKING VARIOUS HEATING FORMULAS.

It is very interesting to check the various theoretical formulas which have been proposed, with actual conditions in the heating of buildings. The empirical formula which is used in Chicago for estimating the heating requirements of large buildings not only is based on experience from heating a large number of buildings, but also has been deduced by taking certain values in the general formula for heating, which is based on the amount of heat radiating surface on the outside of a building and the rate at which the air is changed in the building through ventilation and leakage. There is perhaps no line of endeavor in which it is more necessary that theory and experience walk side by side than in the subject of heating and ventilation. In view of the fact that fairly satisfactory and dependable instruments can now be obtained for measuring the quantity of steam and the pressure which is maintained, a large amount of information should be collected as to the heating requirements in various classes of buildings.

New Ideas in Air Conditioning

By W. E. Watt, A.M., Ph. D.

Muskegon, Mich., has had its worst building condemned by the State Board of Health and now it is the best-ventilated building in the city. Now comes an order for more work for the Muskegon Board of Education. The high school at Joilet —87 rooms—has been accepted and a capacity test was held in the assembly hall with visiting educators looking on. The president of the Board of Education says we have taken a building with a fan that was manifestly too small and made it large enough with less than maximum speed, and we have already saved $500.00 *in fuel this Winter.*

The accompanying article seems to hit the ventilating engineer, but that is not really the case. It hits the data and standards which they have been instructed to rely on and which are wrong. The universities are teaching the errors and the engineers are desirous of finding out why teachers and pupils became anemic when they have done their best to give them pure air.

I permit open windows in all sorts of buildings and give in warm open air schools the same benefits secured in cold schools at great cost.—W. E. Watt.

The request of the editor for a statement of the new work being introduced into the schools of Michigan to get a better quality of air, and better scholarship and health, leads me to make here a few rather brief statements, which I know will be challenged, but which I can not here take space to verify. I shall content myself with the facts without details. One leading architect of the United States said to me one day when he was in agony over unsatisfactory results in a building he had just finished at a cost of more than one million dollars, "There is not one ventilating engineer in this city who can do what he says he will." I asked him how far he would have to go from this city to find the sort of air engineering he was seeking, and he enlarged his statement to include the whole country. His statement is too sweeping, but it was made at a time when had gone the limit in expense, and had procured bad results.

The difficulty in standard ventilation lies mainly in three errors, which have been pretty generally adopted by the profession and our universities, any one of which is sufficient to give bad results.

THE CARBON DIOXIDE ERROR.

The first error is the assumption that foul air falls to the floor. Carbon dioxide is heavier than air by about fifty per cent. Clear carbon dioxide will pour from a dish like water, and lies upon the floor, but it will immediately begin to rise, and diffuse throughout the room. Gases do not separate out into layers as liquids do, but every gas diffuses and fills the whole space regardless of the presence of other gases. For instance, a receptacle may be completely full of air, and then receive without any crowding a complete filling of carbon dioxide, another complete filling of water vapor, and other complete fillings of other gases, each gas finding ample room for itself whether the others are present or not.

Out-breathed air is warmer than the air which we choose to live in, and because it is warm it goes up. It lies in a layer near the ceiling, but not in a distinct layer. It begins to diffuse at once, but is what I call a dead combination of gases, and diffuses quite slowly. It is decidedly different in the case of diffusion of illuminating gas. One cubic inch of illuminating gas released in a large room reaches all parts of it, but the warm effluvia from skin and lungs rise to the ceiling, and may be skimmed off before diffusing very much.

For this reason I use skimming outlets at the ceiling. The standard practice is to dilute the air sewage with new air until the mixture shows but six or eight parts of carbon dioxide in 10,000. If the city fathers should mix the sewage of the city with drinking water, six parts to ten thousand, there would be a great outcry, although what we breathe is of very much more importance than what we drink or eat.

THE ARIDITY ERROR.

Air that is warmed at all becomes somewhat arid. It is well known that unless humidity is applied in winter the conditions for health are not good. A great deal has been said recently about using humidity, but the devices employed have, in many cases, failed to secure satisfactory results, and so many fine, new buildings are being erected this year with no provision for proper humidity.

In a school or church, you must have humidity or stupidity. It often happens that winter air contains less than five per cent. of relative humidity outdoors. When this is warmed the humidity is reduced twenty or twenty-five volumes, making the amount of humidity indoors less than one per cent., and in some cases merely a trace. It is not wise to bring up children in a house that is worse than a drying kiln. No business, study, or mental work of any kind can be well done in a room where the air is dead and drier than that of the desert of Sahara.

But in using humidity it is necessary that the air be alive in order to carry the humidity properly, otherwise it becomes a fog, and the conditions are unsatisfactory. So we must see that the air is not killed by the heating plant, and then we find that less than thirty per cent. of relative humidity is frequently entirely satisfactory, where in dead air two or three times as much water does little good.

THE FRESH AIR ERROR.

The most ignorant janitor of a small church is pretty apt to know that he can heat live air more easily than dead air. Everyone who has mounted a step-ladder in any warmed room knows that the air near the ceiling is not as invigorating as outdoor air, and anyone who has stood on a step-ladder before the inlet of a scientifically ventilated room, finds that the so-called fresh air, on entering the room, is decidedly different from what the ventilating engineers would have him believe.

I am unable to find in any work on ventilation one word about air that is alive, or radioactive, or ionized. Yet the air outdoors is alive, and ionized, and radioactive. Physicians tell us there is no cure for tuberculosis, except outdoor air, good feeding, and rest, and the outdoor air is the main factor. In cases of pneumonia they prescribe fresh air only. What medicine they give is merely given to satisfy the watchers. Live, ionized, radioactive air is the cure for tuberculosis, pneumonia, fatigue, indigestion, constipation, and all the foul air diseases. It reddens the blood, sharpens the intellect, cheers the mind, and produces resistance to fatigue and diseases.

In warming air for our buildings where we throw a house full of air towards the sky every four to seven minutes, it is necessary to heat the air almost instantly. This requires very great heat. This heat takes the life out of the air.

That is why school teaching has become a hazardous occupation in the last forty years. The life insurance companies now rank the teacher at the bottom of the list with the saloon keeper and marble cutter in peril of tuberculosis. This change in insurance risks has been co-incident with the introduction of rapid ventilation in our city schools and colleges.

THE CORRECTED PRACTICE.

By avoiding these errors, it is possible to supply a building with air that is properly warmed, not killed, rightly humidified, and somewhat cooler than the air commonly used.

To equip a new building to do this costs very much less money than the standard equipment, and the running expenses are cut still more drastically. The work is not done to save money, but the air of a building cannot be made right and kept right when the ordinary amount of fuel and current is consumed. I found I had to cut them down in order to treat the air more gently and avoid killing it. I also found that temperatures from 6° to 10° lower than usual are preferred when the air is right. Here is another saving of from fifteen to twenty-five per cent in fuel.

This subject is a complicated one, but problems have been solved so that we may now condition the air in any sort of building using whatever ventilation apparatus has been installed. About the only change noticeable in a school room which has been condemned by the Board of Health and transformed into one of the best rooms in the city, *is a small skim-off high in the wall,* and the cheerful aspect of the teacher and pupils.

We have found that education in live

air, rightly humidified with the air sewage eliminated instead of diluted, is a much easier process than education in a building ventilated according to standard practices. The efficiency of employees in banks, business houses, shops, and factories is noticeably increased. I have some very interesting statistics on this, which I hope to gather into readable shape before long.

In our thin clothing in summer we enjoy air at 60° or 62° F., while in winter with heavy clothing we often find 10° higher quite necessary to avoid a chill. The new practice of air conditioning is merely an attempt to make the indoor air of winter somewhat resemble the outdoor air of summer.

THE BUSINESS OUTLOOK.

III.

By Frank M. Huston,

Financial Editor of the Chicago Evening Post; Editor Rand-McNally Bankers' Monthly.

With prosperity in evidence in all directions and with a year behind us containing developments unprecedented in the history of the country we are entering a period that promises a further broadening of the field of American endeavor. That our war business with Europe has stimulated a revival of general business activity, to an extent unbelievable a year ago, is obvious.

The year to come is likely to develop into a period of stabilizing this activity through an expansion of domestic business. Profits from the war business have been abnormal. This is evidenced by the fact that our volume of trade with foreign countries in the last year totals $5,355,580,000. Out of this we have created a credit balance of approximately $1,747,390,381. This affords us fortification in a financial way that necessarily must minimize the evil effects of the economic readjustment which the cessation of hostilities in Europe will bring.

What the effect of the war will have upon the far future of nations is difficult to foresee. Suffice it, however, to say that there are unmistakable evidences that this country is no longer dependent upon the European war for its prosperity. The tremendous war orders poured in upon us have stimulated but did not create the forces making for great activity here. The United States had been passing through a period of relatively lean years and a fat year was about due. Uncertainty following the outbreak of the war caused hesitancy for a period which the influx of orders to fill the needs of Europe dispelled, until now many lines of trade and manufacture are running at full capacity.

It is well, therefore, to note the salient features bearing directly on the economic position of this country.

First, and foremost, the enormous increase in exports which, combined with lightly increased imports, brought us a total trade exceeding the largest previous year by 25% and yielding a credit balance two and a half times as great as any previous balance in our favor.

Second, increased banking facilities under the operation of the Federal Reserve System and in consequence of an inflow of $415,000,000 in gold, affording us a rapid increase in available credit.

Third, farm products exceeding $10,000,000,000 in value and stimulating a much needed diversification in crops in the south.

Fourth, recovery in railroad earnings, stimulating the impaired credit of the railroads and restoring normal purchasing power to our transportation systems which are the chief customers of other industries.

Fifth, revival and growth of manufacturing under the stimulus first of war orders and of a greatly stimulated home demand, to an extent unprecedented, especially in the steel trade.

Sixth, the absorption by American investors of approximately $1,200,000,000 of our securities formerly held in Europe, without serious disturbance to our own credit situation.

Seventh, the development through the channels of trade and finance of an international, in lieu of a provincial, position in the world's banking, and the reaching out for a more active participation in the world's trade.

Eighth, revival in American shipbuilding and the determination to develop a merchant marine in keeping with the country's resources and the increase in our foreign commerce.

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The Government's Publication of Mid-Day Humidity Readings.

Some time ago the announcement was made in these columns that through the efforts of W. G. R. Braemer, of Warren Webster & Co., the government had arranged for the taking and publishing of mid-day humidity readings at certain of the Weather Bureau stations. Efforts to obtain these mid-day readings for use in connection with the weather charts published in The Heating and Ventilating Magazine have brought out the information that while these records are given out for local publication no permanent record is made of them as yet by the Weather Bureau, except in the case of New York.

It is the intention to incorporate them in the weather charts referred to as soon as the data are available.

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FOLLOWING closely upon the need of adequate ventilation facilities in motion picture theatres comes the news of another new field of activity for the ventilating engineer. This time it is in connection with the ventilation of garages, both public and private. In the last month there have been reported several cases of asphyxiation from automobile gas fumes which Chicago physicians have defined as "petromortis." In these cases the victims were found seated or standing alongside their cars in garages, apparently suddenly overcome while making adjustments or testing the motor.

In commenting on this new danger of working on a motor car in a closed garage, it is urged that if work must be done with the motor running, the doors and windows should be open to provide a free current of air or adequate ventilation provided by other means.

In the cases recently reported it would seem that death came too soon and after too short a period of combustion to be the result of mere oxygen exhaustion of the air in the room, and the conclusion has been reached that they are clear cases of carbon monoxide poisoning.

One remedy proposed is the use of a pipe with a flexible connection attached to the exhaust so that the exhaust of any motor can be conducted out-of-doors. This might well do for the small garage, but in larger buildings used for this purpose it will probably open the way for the installation of complete mechanical ventilating equipments.

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TWO achievements, consummated at the recent annual meeting of the heating engineers' society, will stamp that meeting as one of exceptional importance to the trade. The first is the final approval of the requirements for model compulsory heating and ventilation laws, with minimum provisions for public and semi-public buildings. This code was to be issued early in February with the sanction of the society and is intended for use throughout the country, not only in drafting proposed laws but as a general guide to the profession and to the public in connection with particular installations.

The other achievement is the society's formal action in committing itself to the project of an educational and publicity campaign as developed by a special committee. This campaign is to be conducted on two general lines, one an educational propaganda in the form of lectures, etc., and the other in the compilation of nothing less than a "heating encyclopedia." Details of this project are given in the report of the meeting on another page. They indicate an advance movement whose significance and importance will only be fully realized as the work proceeds.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Twenty-Second Annual Meeting, January, 18-20, 1916

With evidences on every side of increased strength and larger life, the twenty-second annual meeting of the American Society of Heating and Ventilating Engineers, held in New York, January 18-20, last, set new records in attendance, in the scope of its programme and in plans for future activity.

It is safe to say that no project which the society has ever undertaken approaches in importance and extent the plans which were set in motion providing for an educational course for heating engineers and systematic publicity for the heating engineer and his work. This project, which was in the hands of a special committee, was not only endorsed by the society, but was made a part of the coming year's work.

HARRY M. HART.
The New President of the American Society of Heating and Ventilating Engineers.

The plans as at present laid out provide among other things, for the preparation of a heating encyclopedia to cover all phases of the art. Matter for this encyclopedia will be accumulated as opportunity offers, and when sufficient matter is obtained it will be gone over and prepared for publication. It is the purpose to make the encyclopedia so complete and authoritative that it will serve as a standard, comprehensive work on heating and ventilation and also provide a source to which a man can come and expect to find information on any branch of the art in which he may be interested. Other plans of the committee provide for lecture courses, to be given, in some cases, before the society's chapters and in other cases before different organizations, such as men's and women's organizations in the various cities.

It is realized that there will be considerable expense connected with the undertaking, but the possibilities are considered so large and important that it is thought it will not be difficult to find ways and means to finance the plans.

Afternoon Meeting, January 18.

President D. D. Kimball called the meeting to order Tuesday afternoon in the Engineering Societies' Building. Although he did not deliver a formal address, he took advantage of the occasion to make a few remarks. The advance of the art, he said, during the past year has been more rapid than at any other period. The society, he added, is growing to proportions unthought of some years ago. The past year had, therefore, been a most encouraging one and one of the most gratifying features of the work, said Mr. Kimball, was the wide and enthusiastic participation of the members in the work. For the first time the proceedings of the society have been printed up to date, the delivery of last year's proceedings having been made a few days before the present meeting.

Secretary J. J. Blackmore read the report of the council which showed that for the first time in the history of the society the transactions up to date have been printed and delivered. The establishment of the society's journal has been justified by the success it has been from a financial standpoint as well as adding to the prestige of the society. By means of the Journal the papers have been placed before the members well in advance of the meetings.

The society's assets now amount to $11,001, a gain of nearly $200 during the year.

The net increase in membership, it was shown, is nearly three times that of any former year, the net increase being 128.

Applications for charters from two new chapters have recently been received, one at Cleveland, to be known as the Ohio Chapter, and one at Philadelphia, to be known as the Eastern Pennsylvania Chapter.

SECRETARY'S REPORT.

The secretary's report gave some interesting figures regarding the cost of publishing the Journal. The receipts for 1915 were $9,256.05 and the disbursements $9,071.33, leaving the surplus for the year $184.72.

The treasurer's report gave details of the receipts and disbursements

FINAL REPORT ON MINIMUM VENTILATION REQUIREMENTS.

President Kimball then called for a report from the council regarding the proposed minimum ventilation requirements for public and semi-public buildings. Mr. Frank T. Chapman reported for the council that the proposed requirements submitted by last year's committee had undergone final revision. It is a document of some length and will be published in full in the April Journal of the society. Copies in pamphlet form will be available by February 1st.

An important report was then presented by M. W. Franklin, chairman of the educational and publicity committee. This committee was one appointed at the September, 1915, meeting of the society, to consider a definite plan for providing educational courses for heating and ventilating engineers.

Report of Educational and Publicity Committee.

Supplementing the general report of this committee there were sub-committee reports on scope of education, publicity and public lecture courses, ethics and welfare, and finance.

The committee, through M. W. Franklin, chairman, reported that in general the engineering professions and, accordingly, the engineers, have developed as a necessary issue of industrial activities. There were telegraph lines, for instance, before there were electrical engineers. Moreover, the first engineers were connected with manufacturing concerns. The heating and ventilating profession is experiencing the same process of evolution as that of the electrical engineers. The difficulty is that the heating engineer has not yet so far developed that he is generally known to and appreciated by the lay public as a necessary element in the industrial community.

Starting on this premise, the committee called attention to the inadequate preparedness of many entrants into the ranks of the heating and ventilating engineering profession and came to the conclusion that what is needed is an educational propaganda, professional and public, popular lectures, and an ethical campaign of newspaper publicity. The committee also recommended the preparation of a series of text-books forming an encyclopedia. This set of text-books would form the basis of instruction to be given under the direction of the society chapters. It is even proposed that graded diplomas could be given by the society certifying as to the amount of work done by the students.

A synopsis of the proposed educational course divides the subject into three parts: 1, General; 2, Heating; and (3) Ventilation. Under "General" is listed general introductory, physics and physiology. Under "Heating" is given "General," including standards for heating buildings; heat transmission; heat losses; combustion, and chimneys; then "methods of heating," with five sub-headings covering furnace heating, radiation, hot water, steam and gas heating and electric heating. The third sub-heading takes up pipe systems, return traps and pumps, pipe coverings and insulation materials, and various special appliances. The division on "Ventilation" is divided into nine sub-headings.

The report was received by the society and its consideration carried over to a special session Thursday morning.

OPERATING PLANTS IN PUBLIC BUILDINGS.

A report made up of statistics given in the reports furnished by the Treasury Department was made by the committee on operating costs of public buildings, D. M. Quay, chairman. The first table gave quantities and costs for operating the several public buildings, while the second table showed the cubical contents, area in square feet, number of employees and the quantity of electricity used for light and power in the same buildings.

A report followed from a committee on cost of operating, heating and ventilating plants in hospital buildings, A. M. Feldman, chairman. Statistics were included covering 26 separate items for seven hospitals, five located in New York, one in Pittsburgh and one in Buffalo, N. Y. Hospital A, in New York, appeared to have the most economical plant and the committee gave what it considered to be the contributing factors which permitted this economy. Mr. Feldman stated that by mixing coal dust with buckwheat coal a great saving was made in one case in the amount used, the comparative figures being 1,351 tons for 1914, and 1,274 ton for 1915, and the comparative costs being $5,604 and $3,971.

NOMINATING COMMITTEE.

The ballot for next year's nominating committee resulted in the election of John F. Hale, W. H. Driscoll, R. W. Pryor, W. W. Macon and James A. Donnelly.

A number of proposed amendments relating to the method of electing members, etc., were also presented and ordered printed for mail ballot

The first of the professional papers was on "The Establishment of Standard Heating Elements for Cooking apparatus, with special reference to low pressure steam." This paper was part of a report of the joint educational committee presented at the 1915 meeting of the National District Heating Association, and was read by President D. S. Boyden, of that association. Details were given of tests on full-jacketed cast-iron kettles, half-jacketed cast-iron kettles, cast-iron kettles with submerged annular heating element cast in the bottom of the kettle, dish warmers, steam tables and hot water urns.

Mr. Boyden called attention to the surprising lack of data possessed by manufacturers of this type of apparatus, stating that they had little or no data as to efficient and economical operation. He urged a wider adoption of steam cooking, especially in such buildings as hospitals and similar institutions where the time factor would often permit the use of steam for cooking.

The afternoon session closed with the presentation of Prof. W. F. Verner's paper on "Cost of Opening Streets for Pipe Trenches."

Cost of Removing and Replacing Pavements.

As the tearing up of pavements in city streets is one of the principal factors to be considered in constructing a distributing system for heating, the cost per square yard, of removing and replacing the pavement is an important matter. For a sheet asphalt on 6-in. concrete, it was shown that the cost per linear foot of trench was 0.09 cents for a 22-in. trench, running up from that figure to 0.15 cents for a 41-in. trench. The same figures applied to brick on 6-in. concrete. The most expensive pavement to remove is granite block on 6-in. concrete, this cost running from 0.10 cents for a 22-in. trench to 0.16 cents for a 41-in. trench. The cheapest pavements to remove are concrete block on sand, concrete 6 in., and cobblestones on sand, all of which run practically the same at 0.03 cents for a 22-in. trench and 0.06 cents for a 41-in. trench. Cedar block on 6-in.

concrete and creosoted block on 6-in. concrete come a little below the highest figures.

In the tables giving the cost of repairing such pavements, detailed figures are given with the different items separated. The cost per lineal foot of trench runs from 0.17 cents for cobblestone on sand for a 22-in. trench to 0.75 for creosoted block on 6-in. concrete. For a 41-in. trench, the cost varies from 0.28 cents for cobblestone on sand to $1.11 on creosoted block on 6-in. concrete.

Just before adjournment a vote was taken on the applications of Cleveland and Philadelphia members for chapters of the society, to be known as the Ohio Chapter and Eastern Pennsylvania Chapter, respectively. The applications were granted by unanimous vote.

Evening Session, January 18.

The first business of the evening session was the report of the tellers on the society election. The new officers are as follows:

NEW OFFICERS.

President, Harry M. Hart, Chicago; Vice-Presidents, Frank T. Chapman, New York and Arthur K. Ohmes, New York; Treasurer, Homer Addams, New York; Council: Harry M. Hart, Chicago; Frank T. Chapman, New York; Arthur K. Ohmes, New York; Homer Addams, New York; D. D. Kimball, New York; Henry C. Meyer, Jr., New York; Dr. E. V. Hill, Chicago; Frank Irving Cooper, Boston; Walter S. Timmis, New York; C. R. Bishop, North Tonawanda, N. Y.; F. R. Still, Detroit, and W. M. Franklin, New York.

Samuel R. Lewis opened the professional session with a paper on the heating and ventilating plant of the Waite High School in Toledo, O.

Heating and Ventilating Plant, Waite High School, Toledo, O.

This paper described the equipment of the plant, with special reference to the experience gained in connection with the heating of some twenty Toledo schools. The heating and ventilating plants are combined, and no direct radiators are used except for special rooms. The fresh air enters at the second floor level, where it is tempered and then drawn down about 50 ft. to the two supply fans and by them forced through the distributing ducts. These in general are of masonry, about 8 ft. square at the beginning. Space for a future air washer is provided near the air intake, but for the present high pressure steam jets, automatically controlled, are used for humidifying. These are giving fairly satisfactory results.

At various locations convenient to the vertical flues, the distributing heating radiation is placed in plenum chambers, and the mixing damper arranged so that each flue may receive hot or tempered air. The plant may be operated as a gravity heating system when the fans are not in use. Also various apartments may be separately heated and ventilated. This is accomplished from the engine room by pneumatic control from a central indicating switchboard. The heating cost for a season was 0.931 cents per 1,000 cu. ft. of space heated, or 0.76 lbs. of coal per cubic foot of space heated per season.

In discussing the matter of calculating the cubic contents of buildings, Mr. Ehrlich suggested the term of "gross air space" and "net air space," the first including the total inside dimensions and the latter the net indoor space.

In connection with this paper a lively discussion arose over so-called Eastern and Western practice. Mr. Lewis, whose paper, he said, was an illustration of Western practice, emphasized the value of his arrangement for heating rooms with a fan blast system delivering the air first into the plenum chamber and thence to the various rooms. The particular feature, however, which he brought out was the arrangement by which, when one room came up to temperature, the radiation for that room was not shut off but served to heat the air for the other rooms. In this way it was possible, if necessary, to use the entire radiation capacity for supplying heat to a stubborn room that might at the time be difficult to heat.

Mr. Cassell, of the Philadelphia Board of Education, defended Eastern practice in using individual nests of radiators at the bases of the flues and Mr. Donnelly also expressed the view that the advantages claimed for Western practice would be found not to outweigh Eastern methods.

J. F. Cyphers presented a paper on "Operation of Warehouse Heating Plant of Merck & Co., Rahway, N. J."

Operation of Warehouse Heating Plant of Merck & Company.

The buildings heated by the present heating plant are the main warehouse, the liquid building, the workshop building and four small sheds. The main warehouse is of slow-burning mill construction, 120 ft. wide by 650 ft. long, one story high, consisting of 21 saw-tooth sections. The liquid building is of fireproof construction throughout, of irregular shape, roughly 60 ft. x 60 ft., one story in height. The workshop building is of slow-burning mill construction, 60 ft. wide by 90 ft. long, while the four sheds have about 50 to 100 sq. ft. of radiation each, or a total of 600 sq. ft., and are heated only when in use. The total radiation in the warehouse is 17,500 sq. ft., in the liquid building, 1,200 sq. ft., and in the workshop building, 1,000 sq. ft., or a combined total of 20,300 sq. ft. The boiler plant consists of three 150-H. P. horizontal return tubular boilers, forming one and one-half batteries.

The total operating cost for a season, extending from November to May 1, was $1,778, or 0.086 cents per square foot of radiation. Estimating repairs, interest and depreciation at $2,400, the total cost of heating would be raised to $4,200. On this basis the total cost of heating per square foot of radiation was 20.3 cents per year. The actual coal burned came to 31.4 lbs. per square foot of radiation per season.

A comparison was also made with the heating system that was previously in use at this plant, the heating medium being live steam reduced from a pressure of 100 lbs. gauge. In that case the cost was found to be 31.7 cents per year per square foot of radiation. Since in either case live steam had to be used, on account of the extreme length of the building, the small difference in level between boiler room floor and warehouse floor, the large glass area in each saw tooth, the extreme exposure on every side, and the constant temperature control required, the author states his belief that the cost of operation of this heating system is exceptionally low and shows the result of the utmost care.

S. Morgan Bushnell read a paper on "Heating a Chicago Office Building," (This paper is published on another page of this issue)

Another paper on operating costs was one entitled "The Cost of Operating Heating Plants," by George W. Martin.

The Cost of Operating Heating Plants.

This paper is an elaboration of one presented on the same subject before the New York Chapter recently and summarized in THE HEATING AND VENTILATING MAGAZINE for December, 1915. One of the most interesting tables in the paper shows the cost of steam generation in a number of plants. All the plants are largely for heating, hence the load is subject to all the vagaries of the weather. These costs, which included coal, labor, ash removal, make-up water, electric current for blower, electric current for feed pumps, supplies, repairs and miscellaneous items, amounted to $0.272, $0.290, $0.275, $0.534, $0.285 and $0.279 in as many buildings. The first figure given was in connection with a 25-story office building, occupying a plot of 9,000 sq, ft. The second figure was for a large 12-story loft building, containing about 4,000,000 cu. ft. Here steam is used in large amounts for manufacturing throughout the year. The cost figure of $0.275 was for a new office building 25 stories high, with a volume of 6,500,000 cu. ft. No. 4 refers to a loft building in the old commercial section of New York. No. 5 is for a large department store of about 15,000,000 cu. ft. contents, while No. 6 is for a building that receives steam from a boiler plant 750 ft. distant.

The paper also discussed the cost of heating buildings, based on the formulas E. F. Tweedy of the New York Edison Co., and of D. S. Boyden, of the Edison Illuminating Co., of Boston. The author stated that the Boyden formula has an advantage in that it takes into consideration a difference in the operating conditions in the various buildings. Experience is necessary, however, in the use of either formula.

Morning Session, January 19.

The first paper Wednesday morning was on "Air Leakage Through Windows," by Stephen C. Voorhees and Henry C. Meyer, Jr.

Window Leakage.

The fact that few data were at hand regarding the leakage of air around hollow-metal windows was responsible for the investigations described in this paper, The tests, however, were made to include various types of windows; they covered a period of twelve months. One interesting discovery made was that there was a considerable leakage elsewhere than through the cracks between the sash and frame and between the meeting rails. It was found that the air came through the puttied joints of the glass and through the connections of the muntin bars and through the joints of the frame. Every window, therefore, was tested to determine the two classes of leakage: (1) sash perimeter, and (2) elsewhere leakage. The paper includes charts giving the results of these tests, with a description of the apparatus used. The figures for the hollow metal windows, without weather strips, were found to be quite high. For instance, at a differential pressure of 1 in. of water the leakage through some of the hollow metal windows amounted to about 10.5 cu. ft. per minute, and 1.2 cu. ft. with the weather stripped wooden window, or nearly nine times as much.

As the following paper was on a similar subject it was presented before the opening of the discussion. The paper was a report on the establishment of a standard coefficient for heat losses affected by wind movement, made by H. W. Whitten and R. C. March and first presented at the last annual meeting of the National District Heating Association.

The report embraced a study of the records of the Public Service Company of Northern Illinois for the previous two years by which it was shown that where the outdoor temperature ranges from 40° to 70° F., the wind effect is not of great importance. Below 40° it has a steadily increasing value. For instance, between 50° and 40° outdoor temperature, a wind velocity of one mile per hour is equal to 0.75° drop. For an outdoor temperature between 10° and zero, a wind velocity of one mile per hour is equal to 1.3° drop.

Mr. Davis, in discussing this report, considered that the figures for the equivalent degree drop as affected by wind movement, were higher than those that would actually be found. He also brought out the point that it was hardly practicable to take mileage and temperature, add them together and use them as a factor.

Reginald Pelham Bolton also discussed the paper, supporting the latter point, made by Mr. Davis.

F. I. Cooper stated that in installing the window frames the staff beads should be removed and the joint packed before the staff beads were again attached. This, he said, was easy to include in the specifications, but difficult to have the architect accept, because the staff beads are usually so securely fastened to the frame that their removal damages the beads.

Mr. Donnelly suggested that while the society could probably not compile a standard set of specifications, still it would be possible to adopt certain standdard clauses and that one on the proper amount of air leakage through a given window could be drawn up by the society.

Mr. Voorhees said that hollow window manufacturers are fully alive to the need of tighter hollow metal windows and are anxious to co-operate with heating engineers in this direction.

The paper on "Tests on the Recirculation of Washed Air," by G. L. Larson, was presented by Arthur K. Ohmes.

Tests on the Recirculation of Washed Air.

The tests described in this paper were made in the Wisconsin High School. This building is heated with 8,530 sq. ft. of direct radiation, with the addition of 516 sq. ft. of indirect radiation placed between the washer and the fan. The system is of the one-pipe, direct steam throughout. A fan blast system of ventilation is used, with vent ducts which carry the air back to the fan through an air washer and indirect radiators. Provision is made for admitting outside air when necessary. The best material for tracing indoor air currents was found to be very light streamers of silk floss.

Considerable difficulty was experienced in getting the true volume of air entering the rooms. Velocity measurements were taken in all rooms, the registers being removed for the purpose.

When using recirculated water the unexpected result was obtained in that the washer supplied bacteria to the air instead of removing them, and, even when using fresh water continuously, it did not show any marked efficiency as a bacteria remover. These results are directly contrary to those obtained at the International Y. M. C. A. College, in Springfield, Mass.

The author's conclusions are:

1. The tests show that it is both unnecessary and uneconomical to supply large volumes of air to obtain good ventilation.

2. That 15 cu. ft. of air per student would be ample, providing it enters the room at a fairly high velocity and carries the proper amount of moisture.

3. With humidity ranging from 50 to 70%, the occupants of the rooms are perfectly comfortable at a temperature of 65° F., or even less.

4. With humidity of about 60%, the air can enter the rooms at a temperature of 60° without creating any discomfort; in fact, it seems to give life to the air and aids in the efficiency of ventilation.

5. Carbon dioxide content as high as 20 parts in 10,000 does not have a bad effect upon the ventilation.

6. Ventilation by recirculation is both efficient and economical. At the end of a year's run, the teachers are almost unanimous in their praise of the system.

7. With a recirculating system such as this, it requires from 40 to 50% less steam to heat the building while the fan is in operation than would be required if the air was drawn from outdoors for the same length of time.

8. Air movement keeps the temperature uniform in various parts of the room and decreases the amount of steam required for heating. The tests show a minimum saving of about 8%, due to this air movement, and this would be true whether the system is a recirculating one or otherwise.

9. The air washer absorbs a considerable amount of the carbon dioxide contained in the air passing through it.

10. The air washer is apparently quite efficient as a dust remover, but it does not remove bacteria from the air when the washer water is recirculated. The tests show that it actually supplies bacteria to the air under such conditions.

11. In spite of the poor showing of the washer, the air entering the rooms carries no more bacteria than outside air when the relative velocities in which the plates were exposed is taken into account.

Mr Palmer brought out the point that his own investigations showed that air washers do not remove odors, but that on the contrary, odors are more noticeable with high humidity.

Afternoon Session, January 18.

At the opening of the Wednesday afternoon session Arthur K. Ohmes presented a paper describing the Testing Institute for Heating and Ventilating Appliances, at the Berlin University.

Berlin University Testing Institute.

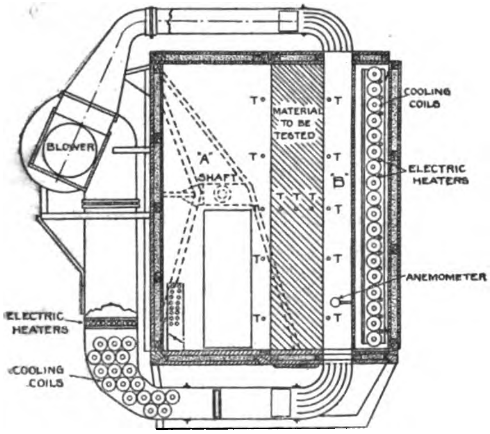
This paper contained an interesting account of the Testing Institute for heating and ventilating appliances at the Berlin University, Germany. The institute is devoted solely to the advancement of the art of heating and ventilating. While the testing of all kinds of heating and ventilating appliances is one of the main functions of the institute, the purpose is also to further the scientific education of heating and ventilating engineer and to teach the future architects the fundamental principles of heating and ventilation. There is also extensive research work done at the institute, with important results, some of which were reviewed by the author.

The institute was started about 20 years ago through the efforts of the late Professor Rietschel and at present occupies a building 400 ft. long, with ten testing rooms, a museum and lecture room.

Being recognized by the entire heating industry of Germany as a national institution, the seal of the institute may well "make" or "break" the successful sale of any article. For this reason many unworthy articles coming on the market are kept off.

The author mentioned briefly some of the principal researches conducted by the institute, the results of which are published in a series of pamphlets. The cost of the pamphlets is quite low. Only our own government's publications, such as those of the Bureau of Mines, can be compared with them in cheapness and quality.

In discussing the paper Albert A. Cary contrasted European and American methods and called attention to the intensive spirit shown by the young engineers with whom he came in contact in France, Belgium and Germany. For instance, he said, they were keenly interested in the American instruments he took with him and were keen to know, not only the details of their construction, but the theories employed in their design. He expected that one of the immediate effects of the European war would be to quicken American engineers to a greater efficiency and application.



PROF. BRABBEE'S METHOD OF TESTING BUILDING MATERIALS FOR HEAT TRANSMISSION AND AIR LEAKAGE.

In commenting on his paper Mr. Ohmes stated that while the matter of heat transmission coefficients was as far from being definitely determined in Germany as in the United States, the Germans have one advantage in that the coefficients now in use are backed by the government so that a heating contractor cannot be sued for supplying insufficient radiation if he has used the so-called standard coefficients. The deficiency in such a case would come under the head of improper building construction.

A. M. Feldman urged the appointment of a committee to devise ways and means for establishing a similar testing station in this country.

Prof. Allen told of experiments he was now conducting at the University of Michigan which gave considerably higher coefficients than those in general use for heat losses through building materials. He stated that it took two years to calibrate the testing box. The results, he said, were so different from those of previous tests that further efforts would be made to verify them before they were published.

It was voted to appoint a committee to take up the matter further, as suggested by Mr. Feldman.

The next paper was one on "Heating and Ventilating Plant of the Equitable Building, New York."

Heating and Ventilating Plant, Equitable Building.

Details are included of the equipment of this structure, the largest office building in the world. It has a total air space of 26,000,000 cu. ft. It is heated by direct steam radiation, with a vacuum return line system, using exhaust steam from the engines, supplemented by live steam passing through a reducing valve. A 24-in. main starting at the ceiling of the 36th floor distributes steam to the various risers in the usual manner. The floors above the 36th are supplied by short up-feed risers connected to the main, and the floors from the 2nd to the 36th are supplied by down-feed risers, which generally start at 5-in. diameter and reduce to a minimum of 2-in. at the bottom. These risers are provided with expansion loops at four different levels.

The return risers start at ¾-in. in size at the top and increase to a maximum of 2½-in. at the bottom. These risers are also provided with expansion loops.

Some idea of the inmensity of the job may be gained from the fact that in the risers there are 61,000 ft. of pipe and 5,000 fittings and in the radiator branches there are 45,000 ft. of pipe and 30,000 fittings. There are 5,000 radiators throughout the building, aggregating 150,000 sq. ft. of surface.

The first floor is heated by means of a separate up-feed system, with separate supply and return mains, in order that the entire floor may be controlled independently of the balance of the building.

Twelve supply fans furnish air to the portion of the building below grade, while one fan is used to heat the main entrance and four fans supply air to the Bankers' Club, on the 38th floor. Sixteen exhaust fans are also included. In addition to the use of cheese cloth filters for the boiler room, etc., there are eight Acme air washers for purifying the air supply to other portions of the building.

The plant is now experiencing its first heating season and no operating cost data are as yet available.

In answer to a question Mr. Driscoll stated that the type of windows to be used was changed after the heating plans had been laid out. He said that an additional allowance of radiation had been made on the upper floors on the original plans and this allowance had been made in the installation.

Prof. John R. Allen presented a paper on "Heat Analysis of a Hot-Air Furnace."

Heat Analysis of a Hot Air Furnace.

In this paper are given the results of tests made to determine the distribution of heat in a hot air furnace and to find the constant of heat transmission for the heating surfaces. The air quantities supplied by the furnace were measured by an anemometer in the center of each pipe at the top. There were also recording thermometers to give the temperature of the outlet air. The humidity of the air was found by using a stationary wet and dry bulb thermometer at the exit. Other records included the temperature of the gases over the fire, the pyrometer used for this purpose having a couple protected from direct radiation by inserting it in a bowl of a porcelain cup, well lined with asbestos. The temperature in the top of the flues was also measured with a pyrometer and in the furnace radiator a high-reading mercury thermometer was used, placed in mercury wells. In the breeching casing the recording thermometer was checked with a mercury thermometer inserted in a mercury well. There was also a CO_2 recorder, a recording draft gauge and platform scales.

Two series of tests were run, one with mixed nut and anthracite and the other with gas coke. Results are given of six successful tests, showing that the efficincy of this hot air furnace to be high. The combustion was good, equalling that of the modern cast-iron steam boiler, and the temperature of the stack gases was not unduly high. The co-efficient of heat transmission as found from these tests is lower than that obtained in cast-iron house heating boilers. This is only an apparent constant, as it is impossible to determine the quantity of heat received by the surfaces from the direct radiation of heat from the fire.

Frank N. Speller then presented a paper on "The Prevention of Corrosion in Pipe." This paper supplemented other papers by the same author on the relative corrosion of steel and wrought iron pipe. He said there had been a great deal of discussion of the matter of corrosion, but little had been said about prevention methods.

The conclusions reached in the paper were that it appears from present experience that developments in the metallurgy and manufacture of steel pipe promise to add 50 per cent. or perhaps 100 per cent. to the life of pipe compared with the service obtained under like conditions ten or twelve years ago. It is possible to predict that de-aeration of the water through the use of plants designed with this end in view should at moderate expense increase the life of some piping systems four or five times. Mr. Speller accompanied his paper with a number of lantern slides illustrating in greater detail the points brought up in his paper, including typical installations.

Morning Session, January 20.

This was a special session, not on the regular programme, for the purpose of considering the proposed plan to commit the society to a project of education and publicity, including the preparation of lecture course and the publication of a society text-book, which will constitute a heating and ventilating encyclopedia.

M. W. Franklin, chairman of the committee having this matter in charge, reviewed the rise of the engineering profession, stating that civil, mechanical, electric, mining and chemical engineers are now on an equal plan with the lawyer, doctor and men of similar professions.

He also pointed out that natural evolution is slow and that the choice was before the society of taking effective steps now to make the heating art one of the recognized learned professions, or to let it reach that plane by natural growth. In either event, he said, he foresaw such an evolution.

At the same time it was highly desirable, he said, that the profession have some guides which might serve as general standards in the way of engineering data. In other words, while it was not possible to say the last word in heating and ventilating engineering it was feasible to say the first word.

Professors Kent, Allen and Carpenter all spoke in favor of the plan. Professor Kent estimated that the cost of a comprehensive text-book would run up to $20,000. Prof. Carpenter referred to the activities of the automobile manufacturers and stated that they started out to compile a text-book, and while the plans were not carried out exactly as planned, it did result in the development of standards as to parts and accessories that have proved most valuable to the automobile trade.

Dr. E. V. Hill, head of the ventilation division of the Chicago Department of Ventilation, urged the appointment of an editor-in-chief to have charge of a society text-book, to be employed by the society, and to devote his whole time to the project.

It was finally voted to adopt the report of the committee and continue same to work in co-operation with the council of the society towards the furtherance of the general plan, as outlined in the report.

Afternoon Session, January 20.

A paper by Secretary J. J. Blackmore opened the Thursday afternoon session with a paper entitled "Can We Standardize the Requirements of Ventilation?"

Can We Standardize the Requirements for Ventilation?

Mr. Blackmore has here assembled a comprehensive and very readable summary of present-day thought on the subject of ventilation, with special reference to the developments of the last few years. All of the important theories that have come up recently are included, and the conclusion is reached that a thorough diffusion and a constant movement of the air in the rooms of our buildings is the most important factor in the production of good ventilation, and that if the location of the fresh air inlets by which fresh air is delivered to rooms is such that the current does not reach every part of the room, such rooms should be provided with desk fans, or fans of some other type, so placed that they will insure absolute diffusion and continuous movement of the fresh air to all parts of the room.

In connection with a study of the outdoor relative humidity conditions, the author presents tables covering the records for the year 1914 in four cities, three of which are widely separated. The Chicago figures, for instance, showed that the highest mean relative humidity for the winter was 81 per cent. and the lowest 54 per cent. In Burlington, Vt., the highest was 83 per cent. and the lowest 58 per cent. In Springfield, Ill., the highest was 87 per cent. and the lowest 54 per cent., while in Fresno, Cal., the highest was 92 per cent. and the lowest 33 per cent. The varying times at which these high and lows occurred led the author to state that, while we should have no trouble in ascertaining what is the best relative humidity, the figures show that we are accustomed to considerable fluctuations. He adds that it is probably in respect to humidity that we have gone to extremes in producing artificial conditions, greatly to the detriment of our physical welfare.

Dr. E. V. Hill, in opening the discussion, submitted a set of standards for ventilation in actual use by the Chicago division of ventilation. These were: Air supply, 30 cu. ft. per minute per person; air movement, 2½ ft. per second; parts of CO_2 in 10,000, 8 parts; temperature, degrees F., 68; relative humidity, 42 per cent.; dust count, 100,000 particles per cubic centimeter; bacteria, 12 colonies per plate.

A paper was then presented on "Ventilation of Homes," by the Chicago Commission on Ventilation.

Ventilation of Living Quarters.

The ideas brought out in this paper are based on the proposition that the conditions of a spring day outdoors, with sunshine and a cool breeze, should be approximated as nearly as possible indoors. Studies are included of the air currents in four residences. Drawings of the houses are given, showing the air currents and setting forth the pertinent temperature, moisture and wind conditions, both indoors and out. The air currents were traced by watching smoke from burning Chinese punk placed in various parts of the rooms and in the different openings and also by the use of fine ravelings of silk floss.

Following are the conclusions reached:

1. The effect of the direction of the wind outside is very much influenced in its relation to the currents inside of a house by the local conditions of the adjacent buildings and obstructions and by the house itself.

2. Air currents as a general rule seek the easiest way in and out of a house.

3. The more inlets there are open on the side facing the wind the better the ventilation, provided there are openings on the leeward side.

4. Adequately to ventilate a home requires sufficient inlet and outlet openings.

5. The efficiency of ventilation increases with any increase in the difference between the temperatures indoors and outdoors.

6. Better results are usually possible when ventilating the entire house than when ventilating only one room.

7. Proper distribution of fresh air is more difficult to attain than proper volume. Part of a room may receive good ventilation, while other parts are stagnant.

8. Furniture exerts a material influence on air currents, and conditions may be improved by intelligent placing of the furniture.

9. Eddies tend to form wherever the air currents are blocked.

10. The distribution of the air is best obtained by proper distribution of the inlets and outlets.

11. An open stairway tends to cause a current of air to rise through it, even though the windows may be closed.

12. An open shaft, like a large chimney centrally placed, would assist materially in ventilating a house.

The commission comes out as a strong advocate of the use of electric fans in households, not only to create currents of air in the directions desired, but for use in blowing air over radiators to increase the amount of heat given off. Artificial moisture introduction is also recommended, either through the use of water pans or, where steam heating is installed, through the admission of steam direct to the air.

It was explained by Mr. Lewis that the houses in which the tests were made had all the windows wide open during the tests. The tests were made in the summer time.

The concluding paper was "An Outline of the Activities of the New York State Commission on Ventilation for the Year 1915." During the past year certain of the studies on temperature and stale air have been repeated. In addition to this, studies have been made on (1) the relation of heat and cold to respiratory effects, (2) the influence of humidity on comfort and mental work, (3) methods of determining the dust content of air, (4) the comparative effects of different types of natural and mechanical ventilation on comfort, mental efficiency and physical condition, (5) the course taken by air currents in a fan ventilated room. As much of the work is being reported for verification, no broad conclusions were presented.

Frank T. Chapman opened the discussion and proposed a resolution expressing the appreciation of the society to the New York State Commission on Ventilation for the account of its work and also its gratification to have it brought out that the accepted ventilation standards are confirmed from a physical standpoint, as well as from a purity standpoint.

Mr. Chapman called special attention to the suggestion brought out in the paper that square feet of floor space per 100 lbs. of flesh is a much more instructive figure than square feet of floor space per person. Heat and respired air output vary closely with a person's weight. The average child of the first grade, it was stated in the report, weighs 49 lbs., whereas eighth grade pupils weigh 100 lbs. Dr. E. V. Hill also endorsed this method of figuring requirements and results.

The new president, Harry M. Hart, was then installed by the retiring president, D. D. Kimball. President Hart called Vice-Presidents Frank T. Chapman and Arthur K. Ohmes to the rostrum and each acknowledged the honor done them and their interest in the society's progress. Treasurer Homer Addams and the council members present were also duly installed.

The meeting then adjourned.

Heating Engineers' Dinner.

Following the custom established last year, the annual banquet of the heating engineers' society took the form of a dinner dance. It was held in the Belvidere Room of the Hotel Astor on Wednesday evening, the second day of the meeting, and was attended by some 175 guests. The diners were seated at individual tables, a space for dancing being left in the center of the room.

Most of the guests were primed for the surprise presentation which had been arranged in honor of Frank K. Chew, long an active member of the society, which was to take the form of a loving cup, a bound volume of testimonial letters and a set of the new edition of the Encyclopedia Britannica.

Before this happened, however, the program called for a toast to "The Old Year," which was responded to by President D. D. Kimball, who also acted as toastmaster Mr. Kimball said the spirit of co-operation shown by the members was the most important item of the old year and he referred to the way this was shown in the work of the various committees.

He then called upon the president-elect, H. M. Hart, who spoke to the toast, "The New Year." Mr. Hart said the standard set by the retiring administration would be hard to maintain. The society had had a wonderful year of activity, but the various projects were so well advanced that there was the highest encouragement in the outlook for his term of office. He reminded his hearers that the society is for the benefit of the members, and not the members for the benefit of the society, and it was essential that it be conducted for the greatest good of the members.

To Percival H. Seward had been assigned the duty of making the surprise presentation to Mr. Chew. His subject was the innocent-looking toast, "Loyalty to the Society Personified." Mr. Seward spoke first of the necessity of members being prepared to do their duty in the society and then he declared that the society had a type of a man who was not only so prepared, but who had for many years furnished an example as an effective worker.

As he mentioned the name of "Frank Chew," the diners burst into applause which was only equalled by their appreciation of the surprise evident on the part of Mr. Chew.

LOVING CUP PRESENTED TO FRANK K. CHEW.

The loving cup which Mr. Seward then presented to Mr. Chew bore the inscription: "To Frank K. Chew, a token of 21 years of unremitting service with the American Society of Heating and Ventilating Engineers, January 19, 1916."

In accepting the gifts, Mr. Chew, after expressing his thanks and appreciation, jokingly warned the members that if the presentation was intended to retire him as a worker there was a surprise in store for the members, as the loving cup would be an inspiration to him to renewed effort in the society's interests.

Dr. D. S. Jacobus, president of the American Society of Mechanical Engineers, was then introduced and was warmly greeted. Dr. Jacobus declared that this is the day of the engineer, who is rapidly coming into his own. He also spoke of the tendency towards standardization in engineering work and urged a closer co-operation on the part of engineering societies to further standardization of practice and materials. He referred to the success achieved in this direction with respect to automobile accessories and pledged the mechanical engineers' society towards co-operation with the heating engineers' society in every way possible.

The concluding toast was "Getting Together," the speaker being Albert E. Roberts. Mr. Roberts presented in an eloquent manner the high ideals of brotherhood which were coming to be recognized as a vital principle of human activity. The war now raging in Europe, he said, was a terrible object lesson of the need of this great ideal. On our children, said Mr. Roberts, would devolve the great task of helping to mend the bitterness that would long outlast the war itself, and whatever our field of activity, whether engineering or some other field, the great duty of the present generation was to develop a spirit of closer and more practical co-operation, not only for our own benefit, but as an inspiration to the coming generation.

This concluded the speech-making, and the remainder of the evening was given over to dancing.

Diversions for the Ladies.

While the men were engaged at the professional sessions of the meeting, the ladies were being entertained by a committee composed of J. I. Lyle, chairman; Douglas Sprague, G. G. Schmidt, B. K. Strader, R. W. Pryor, N. L. Schloss, H. G. Issertel and J. Barton Garfield. On the first day of the meeting Mr. Lyle was suddenly called away by the news that his home in Plainfield, N. J., was in flames. The fire, it was learned, had started at about 10 P. M., and while the family had retired, there were. fortunately, no fatalities. The house itself, however, was badly damaged by flames and water. Many expressions of sympathy were expressed to Mr. Lyle over his misfortune.

The principal events for the ladies were a trip to the Metropolitan Museum of Art, Tuesday afternoon, a visit to the Biltmore Ice Gardens for open air skating, on the roof of the Biltmore Hotel, Wednesday afternoon, and a matinee party at the Hippodrome, Thursday afternoon. Here the attraction was "Hip, Hip, Hooray," with Sousa's Band and the ice ballet.

Byron T. Gifford Addresses Illinois Chapter on "Central Station Heating."

A review of central station practice and the promising outlook for this industry were features of an address delivered before the Illinois Chapter at its January meeting, January 10, by Byron T. Gifford, chief engineer of the American Public Utilities Co., Grand Rapids, Mich. Mr. Gifford is the author of the well-known work, "Central Station Heating," and his remarks were based on a wide experience in this field. He stated that there are about 400 central station heating plants in the United States and he brought out the fact, perhaps not generally known, that the largest plant of this kind is that of the New York Steam Company, in New York.

Mr. Gifford gave some particulars of the plants in La Crosse, Wis., and in Indianapolis, and declared that the business may be taken up profitably, especially in towns of 10,000 population and over. In Indiana, where this type of heating has developed rapidly, there is some $7,000,000 invested in central heating systems.

Methods of overcoming leaks from underground mains were discussed, one method being the welding of joints. It is also becoming the practice to increase the metal at the rib approximately 33 1/3%.

In the case of the La Crosse plant, changes in the underground heating mains had resulted in reducing the hot water temperature drop from 4° to 2° F. in a circuit of 14½ blocks.

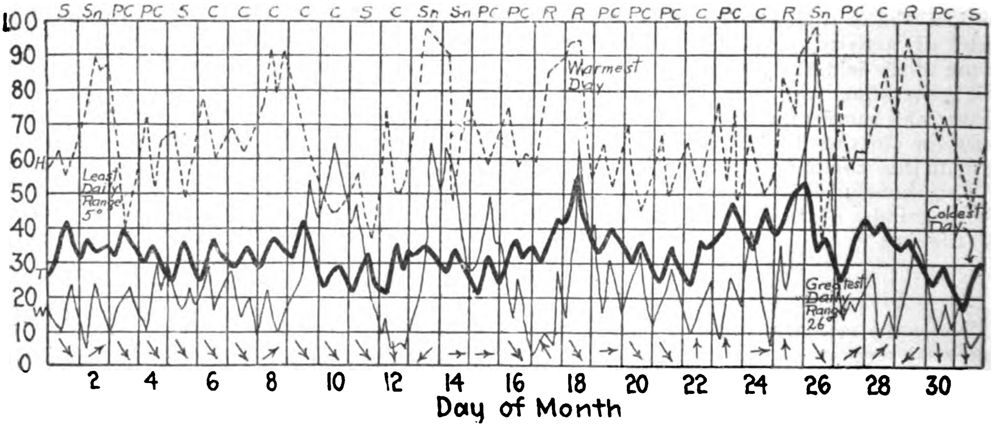
He said a safe rule in central station operation was to limit the distance for transmitting steam or hot water to ten blocks from the plant. In Indianapolis, the longest carry for the steam is 6,200 ft.

Mr. Gifford emphasized the urgent need of a hot water B.T.U. meter that would measure the heat in the outgoing and incoming flow of water in central hot water heating plants.

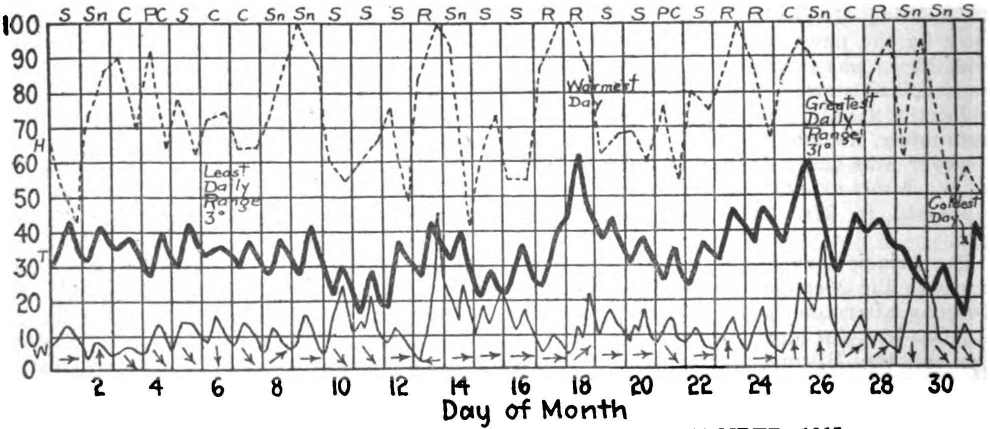
The meeting followed a chapter dinner at the Hotel Morrison, Chicago, and was attended by thirty members, President E. L. Hogan being in the chair. It was announced that the February meeting will be addressed by Secretary J. J. Blackmore, of the American Society of Heating and Ventilating Engineers. This meeting will be held February 14. The principal speaker at the March meeting will be J. T. Seeley, assistant manager of the Chicago Elevated Railways.

The Weather for December, 1915

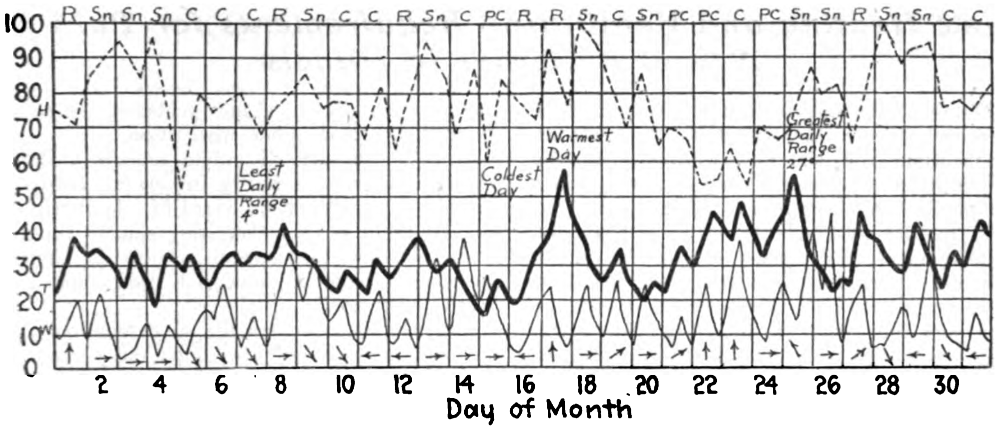
	New York.	Boston.	Pittsburgh.	Chicago.	St. Louis.
Highest temperature, degrees F.............	55	61	58	42	56
Date of highest temperature..................	18th	18th	17th	23d	22d
Lowest temperature, degrees F..............	17	16	16	8	12
Date of lowest temperature.................	31st	31st	15th	20th	28th
Greatest daily range, degrees F.............	26	31	27	19	22
Date of greatest daily range................	26th	26th	25th	15th	26th
Least daily range, degrees F................	5	3	4	3	3
Date of least daily range..................	2d	6th	7th	9th	12th
Normal temperature for month, degrees F..	33.5	34.6	32	29.1	35.4
Normal mean temperature for month, deg. F.	34.5	31.6	34.7	29.3	35.5
Total rainfall, inches.......................	2.23	3.94	3.85	1.31	3.34
Total snowfall, inches.......................	8.1	6.7	8	9.2	13
Normal precipitation this month, inches......	3.43	3.4	2.73	2.07	2.23
Total wind movement, miles................	15,885	8,849	9,514	9,302	9,430
Average hourly wind velocity, miles.........	21.4	11.9	12.8	12.5	12.7
Prevailing direction of wind................	N.W.	W.	W.	W.	N.W.
Number of clear days.......................	4	13	0	5	9
Number of partly cloudy days..............	12	4	5	9	8
Number of cloudy days.....................	15	14	26	17	14
Number of days on which rain fell..........	12	12	17	13	9
Number of days on which snow fell........	4	7	11	8	3
Snow on ground at end of month, inches....	..	4	..	0.3	3



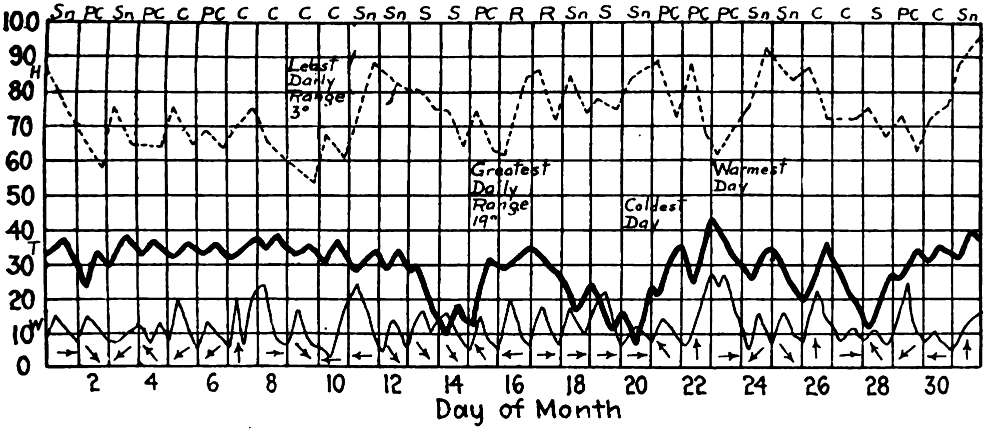
RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1915.
(Hourly Readings of the Relative Humidity Are Plotted on This Chart.)



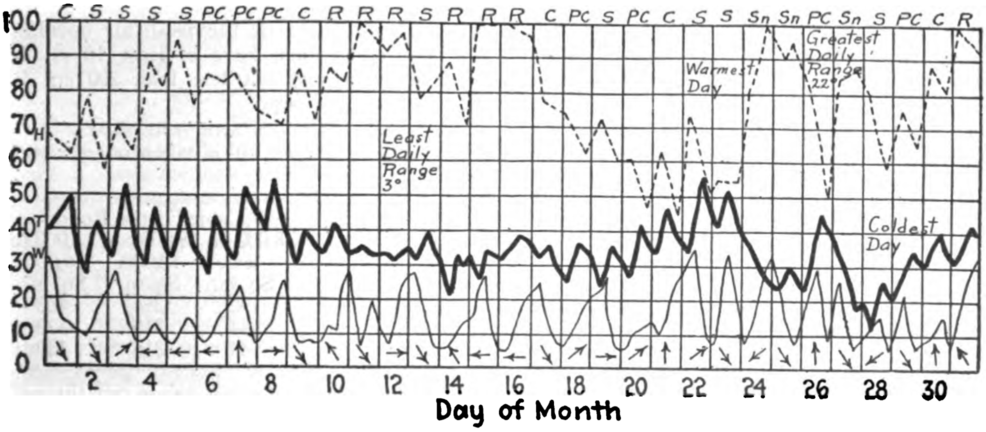
RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1915.



RECORD OF THE WEATHER IN PITTSBURGH FOR DECEMBER, 1915.



RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1915.



RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1915.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

New Heating and Ventilating Requirements for Public School Buildings in Illinois

Notable amendments to the Illinois School Law, which were passed at the last session of the Illinois legislature, materially affect the requirements for the heating and ventilation of public school buildings in that state, as well as the lighting, seating, water supply, toilets and safety against fire in the public schools. Attention is called to the fact that in the case of new or remodeled buildings the law goes into effect at once. But for buildings already in use the penalties cannot be enforced until March 1, 1917. School officers are advised to begin at once and do what can best be done now. By March 1, 1917, they must be able to meet all the requirements of the law.

THE NEW LAW.

The requirements in question are contained in Sections 3, 15, 35 and 114-119 of the "School Law Relating to the Sanitary Conditions of School Buildings." The extracts mentioned as well as the specifications for the minimum requirements for heating, ventilation, etc., are published as "Circular No. 88" by F. G. Blair, state superintendent of public instruction.

Section 3, Paragraph 13, states that it is "the duty of the superintendent of public instruction to prepare, with the advice of the State Board of Health, the state architect and the state fire marshal, for school directors and boards of education, specifications for the minimum requirements for the heating, ventilation * * * which will conserve the health and safety of the children attending the public schools."

Under Section 15, devoted to the "duty of the county superintendent of schools," it is stated that "the duty of the county superintendent of schools shall be to inspect the plans and specifications for the heating, ventilation, lighting, seating, water supply, toilets and safety against fire for public schoolrooms and buildings submitted to him by boards of education or boards of directors, and to approve all those which comply substantially with the specifications prepared and published by the superintendent of public instruction."

Also "to inspect all public schools under his supervision and notify in writing before the first day of April the board of school trustees, or other boards exercising similar functions, whether the several schools in their jurisdiction have or have not been kept as required by law."

Provision is made for the condemnation of such buildings if they are found not to come up to the requirements in any way. There is also a clause which provides for the withholding of the part of the distributive funds apportioned to the various school districts in cases where the requirements are not met.

Regarding the submission of plans, it is specified in Sections 114-119 that "before erecting or remodeling a public school building the board of directors or the board of education in districts containing fewer than 100,000 inhabitants shall submit plans and specifications respecting heating, ventilation, etc., to the county superintendent for his approval.

MINIMUM REQUIREMENTS.

Acting under the law, Francis G. Blair, state superintendent of public schools, has made out a set of standard minimum requirements, the principal items of which are given herewith:

ROOM HEATERS AND VENTILATORS.

In connection with the requirements where room heaters are used, it is provided that the cross-sectional area of the opening into the foul air vent shall be equal to that of the cross-sectional area of the fresh air opening. All classrooms must have at least 16 sq. ft. of floor space and not less than 200 cu. ft. of air space per pupil.

FRESH AIR DUCTS AND VENT FLUES.

A. When the foul air is taken out through the smoke flue:

	Cubic Feet in Room		
	8,000 or less. Sq. in.	8,000 to 12,000. Sq. in.	12,000 to 16,000. Sq. in.
Cross-sectional area of smoke flue not less than	192	256	400
Cross-sectional area of foul air vent into chimney not less than..	144	216	320
Cross-sectional area of fresh air intake not less than	144	216	320

B. When the foul air is taken out through a flue separate from the smoke flue:

	Cubic Feet in Room		
	8,000 or less. Sq. in.	8,000 to 12,000. Sq. in.	12,000 to 16,000. Sq. in.
Cross-sectional area of smoke flue not less than	81	144	216
Cross-sectional area of foul air vent flue not less than.........	192	256	288
Cross-sectional area of fresh air intake not less than	192	256	288

The cross-sectional area of the vent flue shall be at least equal to the openings specified above.

BASEMENT HOT AIR FURNACES.

When a basement furnace is used there shall be an intake for fresh air from outside the building and also a cold air intake from inside the schoolroom. Dampers shall be provided which will make it possible to take all the air from one source or to take a part from both sources at the same time.

The chains which regulate the dampers for the admission of air to the furnace and those which control the drafts of the furnace shall extend into the schoolroom.

There shall be an entrance to the basement from within the building as well as from without.

The floor of the basement shall be concrete or brick.

Warm air from the furnace shall be admitted into the room at the wall at least 6 ft. above the floor.

The opening into the foul air flue shall be at the floor level and the foul air flue shall be so constructed that it will be heated by the smoke flue.

The return cold air opening from the room as well as the opening from the outside shall be at the same wall as the warm air inlet and shall be 2 in. above the floor level. The grating over this opening shall be leaned against the wall at an angle of 45°. The openings from the outside and the inside shall connect with the duct to the furnace. The damper shall be constructed so as to close either opening and leave the other open.

A foot warmer or warm air register shall be placed at the floor level in the wall. No warm or cold air register shall be placed in the floor where it can be walked on or sweepings fall into it.

STEAM HEATING.

The Fan System—When the fan system of ventilation is used, the warm air flues shall have a cross-sectional area of not less than 9 sq. in. for each occupant of the room. The vent flues shall have a cross-sectional area of not less than 10 sq. in. for each occupant of the room.

The Gravity System—Where the gravity system of ventilation is used the warm air flues shall have a cross-sectional area of not less than 16 sq. in. and the vent flues 14 sq. in. for each occupant of the room.

Air Passed Through Radiators—When fresh air is taken directly into the room and passed through the radiators, the combined cross-sectional area of all the openings shall be not less than 9 sq. in. and that of the vent flue not less than 10 sq. in. for each occupant of the room.

When the methods mentioned in the last two paragraphs are used, each foul air flue shall be provided with a radiator of at least 9 sq. ft. of radiating surface.

Moistening the Air—In all systems of heating ample provision shall be made to moisten the heated air.

The county superintendents will be called on to fill out a definite report covering some fifty separate items, including measurement of the floor space; cubical contents, window space, sizes of ventilating flues, etc. After his inspection, he is to be provided with a score card which he is to fill out, showing the points that are unsatisfactory as well as his suggestions for improving them.

LEGAL DECISIONS

Assignability of Heating Contract.

A contract between a company and a consumer bound the company to furnish to the consumer, its successor or assigns, to certain specified premises, all electric service for lighting, fans, and heating required by the consumer, and the consumer agreed to pay therefor. The consumer sold its business and assigned the contract to the buyer. The company refused to supply the buyer with electricity at the rate stipulated in the seller's contract, claiming that the contract was not assignable. It was held that the contract did not create obligations personal in such a sense as to render the contract nonassignable within the rule that when rights arising out of contracts are coupled with obligations to be performed by the contractor and involve such a relation of confidence that it must have been intended that the rights should be exercised and the obligations performed by him alone, the contract, including both his rights and obligations, cannot be assigned without the consent of the other party. Here there was nothing on either part calling for the exercise of personal service. The contract was on a printed form, and contained printed stipulations on the black, concluding with the following: "This agreement is not transferable." It was held that this did not render the contract non-assignable, being repugnant to the agreement to supply the consumer, his successors or assigns, and the first provision would control, especially as the stipulation was not in the face of the contract, but printed on the back. The court cited the case of Voigt vs. Murphy Heating Co., 164 Mich. 539. The owner of a large office building had a contract with a company furnishing steam from a central plant for heating purposes. He sold the building and assigned in writing the heating contract. The heating company sent the purchaser a duplicate of the original heating contract, with the exception that the rate was higher. The parties could not agree. It was held that the heating contract was assignable, and passed, with all its benefits and privileges, to the purchaser by virtue of the assignment. Leader Co. vs. Little Rock Ry. & Electric Co., Arkansas Supreme Court, 179 S. W. 358.

Failure to Heat Premises—Tenant's Remedy.

Action was brought by a tenant against a landlord to recover sums expended in heating the leased premises, due to the landlord's failure and refusal to furnish heat, when the plaintiff's lease required that the lessor should furnish "steam heat when necessary, from October 1 to April 30, for ten hours per diem." The Illinois Appellate Court held that if a lessor fails to furnish heat as stipulated in a lease, the tenant may recoup the cost from the rent or sue upon the covenant. The plaintiff was held entitled to prove the failure to furnish heat, and testimony as to temperature was admissible. Globe Association vs. Briggs, 190 Ill. App. 60.

Contract for Sale of Ventilating Fan—Rescission.

In an action to recover the price of a ventilating fan installed in the defendant's mine, it appeared that two weeks prior to the delivery of the fan the plaintiff, on looking over the specifications of the fan, found that they did not fit the conditions of the mine, and concluded there ought to be a change in one of the dimensions as set forth in the agreement; that, instead of having the fan 48 in. in diameter by 32 in. wide, they would have better results if the fan were reduced to 27 in. in width. He notified the defendant of this; the defendant made no reply. The defendant accepted the fan, and used it for one year and nine months, after a defect in the installation had been remedied by the plaintiff. It was held that the plaintiff was entitled to recover the whole contract price, as there was no evidence of a rescission of the contract, or an offer to return the fan, or any testimony from which a jury could fix with any degree of certainty any damages sustained by the defendant.

Where there has been substantial and bona fide performance of an entire contract, but failure in some particulars not essential to the enjoyment of the part performed, there may be a recovery of the contract price subject to the right of the defendant to set off damages resulting from the breach, but if there is no evidence of such damages, there can be no set off. Where a party discovers facts, which warrant rescission of his contract, it is his duty to act promptly, and in case he elects to rescind, to notify the other party without delay. What is a reasonable time or undue delay when the facts are undisputed, is a questions of law to be determined by the court. Robinson vs. Listonburg Coal Mining Co., 58 Pa. Superior Court, 136.

Fumes from Gas Water Heater.

Action was brought by a landlord against a tenant to recover damages resulting from the presence of gas fumes in a bathroom from the use of a gas water heater without a proper vent pipe connection. It was held that an allegation that the tenant did not know the danger of using a water heater did not show that the tenant had a right to rely on the existence of a vent pipe or connection therewith, and stated nothing for which the landlord was responsible. The declaration failed to disclose any defect in the vent pipe, or, if one, that it was concealed, or that knowedge of it was chargeabe to the landlord, or that it was not discoverable or ascertainable by the tenant. It was held to lack the elements essential to such a cause of action. Gathemann vs. Rosenfeld, 190 Ill. App., 110.

◆

Contamination of Air by Automobile Exhausts.

A new disease, which has been classified as petromortis, has been found to lurk in the exhaust of automobiles, according to Dr. George L. Apfelbach, of the staff of the Illinois state factory inspector. Dr. Apfelbach has just prepared a study of the poisonous effects of the exhaust gas from gasoline cars which will appear in the forthcoming report of the state factory inspector. His experiments have led to the conclusion that petromortis, first brought to public notice by the death of Attorney Eugene M. Bumphrey, in Chicago, is principally due to carbon dioxide gas.

HEADACHES FROM GAS.

"The exhaust gas is rapidly diffused on the street or in the open," Dr. Apfelbach says in his report. "Nevertheless, we occasionally hear of cases of mild nausea and headache having occurred in the crowded downtown districts in the large cities on rainy days. The condition, however, becomes quite serious if the motor is allowed to run in a closed garage.

"Investigation was made by interviewing chauffeurs of five taxicab companies in Chicago and by obtaining information first hand from a physician who spends one hour every day in the main garage of such a concern. The medical man stated that he frequently hears that mechanics and chauffeurs complain of vertigo, headache and nausea, especially in the winter months and on rainy days."

CONTAINS NO HYDROGEN.

With the assistance of Joseph A. Schumacher, of the city gas bureau, Dr. Apfelbach analyzed the exhaust from fourteen motor cars, with the following result:

Content.	Per cent.
Carbon dioxide	6.7
Carbon monoxide	9.3
Oxygen	1.4
Illuminants	.3
Nitrogen	82.2
Hydrogen	0.0

Dr. Apfelbach's conclusions follow:

1. The exhaust of autos contains a very toxic gas, the carbon monoxide content being over 9%.

2. Since the gas is so toxic, the public should be warned. No motor should be allowed to run in any garage unless the ventilation be extraordinarily good. To go alone into any garage where a gasoline motor is running is entirely incompatible with the present day slogan of "safety first."

3. The chief inspector has instructed all deputies to prohibit the emptying into any workshop of any stationary gasoline engine exhaust. The "health, safety and comfort law" provides for this supervision.

DIFFERS WITH DR. ELLIS.

Dr. Apfelbach took issue with Dr. John D. Ellis, head of the department of educational diseases, Rush Medical College, who declared the toxic elements of the gasoline fumes were splitting products of benzine.

"Benzine is distilled from gasoline, so there would be practically no benzine fumes in the exhaust of a car," Dr. D. Apfelbach said. "Our experiments showed no decidedly poisonous gases with the exception of carbon monoxide. But the amount is so large that running a motor 15 minutes in a closed room might be fatal. In fatal mine accidents 1.7% carbon monoxide has produced death."

◆

Proposal to Abolish Fahrenheit Scale in Government Publications.

A bill has been introduced in Congress to abolish the Fahrenheit thermometer scale, now in general use in this country, and substitute for it the Centigrade scale as the standard in United States Government publications. In order to obtain an expression of opinion as to the effect such a change would have on commercial and other activities, the New York office of the United States Weather Bureau is sending out a question sheet to those interested with a view of ascertaining the general opinion on the matter.

◆

Pipe Symbol Chart.

By T. W. Reynolds.

The symbols shown on the accompanying pipe symbol chart are more for general use in piping work and are significant of the meaning they are intended to convey. Some engineering offices differ slightly in the type of symbols used and those given in the chart are suggestive only.

Symbols other than those for pipe should be drawn in size nearly equal to that of the actual space on the scale occupied by the article so symbolized.

The use of colors on the tracings aids in the ready determination of the piping runs, fittings, etc. Similarly the black lines show up much more distinctly upon the prints than do the other colors.

The piping around traps could be omitted, if desired, and merely an outline of the trap shown. In any event, a typical detail of connections at traps should be shown, to serve for all traps of the type indicated.

◆

Sampling and Analyzing Flue Gases.

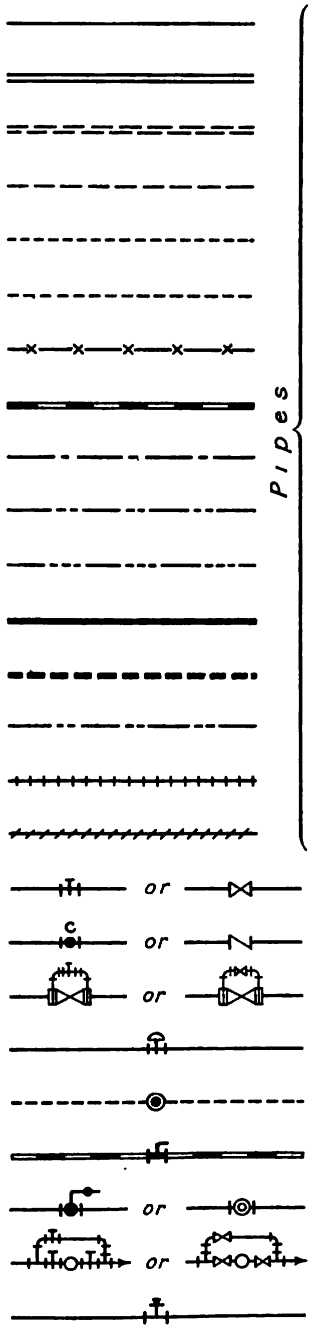
As the analysis of flue gases tends to develop better methods of firing, which in turn reduces waste of fuel, the Bureau of Mines, Department of the Interior, in Bulletin 97, "Sampling and Analyzing Flue Gases," by Henry Kreisinger, engineer, and F. K. Orvitz, assistant chemist, just issued, presents for the benefit of those in charge of boiler plants and all other persons interested detailed information on methods of sampling and analyzing flue gases, and on the utilization of the analyses in promoting boiler-room economy.

◆

Cost of Operating Electric Fan Over Radiator.

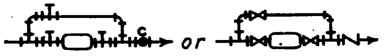
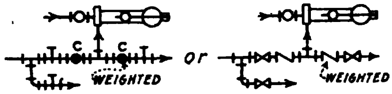
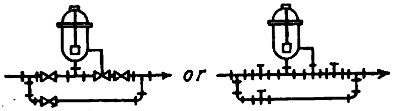
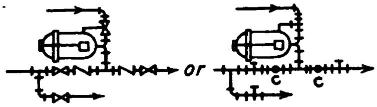
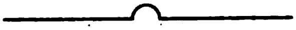
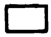
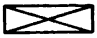
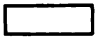
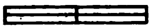
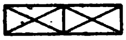
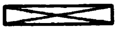
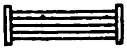
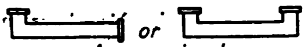
When the outside temperature is between 4° and 35° F., an electric fan placed behind the radiator in a room will increase the comfort of the room and make it possible to use all parts of it. With coal at $4.00 a ton, the average saving on coal needed amounts to 6.4 cents a day. The cost of electricity to drive the fan at 6 cents per kilowatt is 4.6 cents. There is, therefore, a saving of 1.8 cents, in addition to the added comfort.—*Electrical World.*

PIPE SYMBOL CHART



Symbol		Description	Color	Remarks
	Pipes	L P Steam	Red	All Fittings shown in Black
		H P Steam		
		H P Exhaust		
		Return	Blue	
		L P Drip	Red	
		H P Drip	Green	
		Vapor or Vent	Black	
		Blow-Off		
		Cold Water	Orange	
		Hot Water Supply		
		Hot Water Return		
		Soil and Waste	Black-Heavy	
		Vent (Plumbing)		
		Refrigeration	Green	
		Vacuum Cleaning		
		Present Piping to be removed	Black-Green Cross Lines	
or		Gate Valve		Black-Lines colored as given under Pipes
C or		Check Valve		
or		H.P Valve with By-Pass		
		Automatic Diaphragm Valve	Temperature Control System	
		Vacuum Return Valve		
		Blow-Off Cock		
or		Back Pressure Valve	First-Lever Type Second Diaphragm Type	
or		Pressure Reducing Valve		
		Plugged Tee		

PIPE SYMBOL CHART
(CONTINUED)

Symbol	Description	Color	Remarks
	*H. or L.P. Trap (Bucket Type)*		*Black-Lines colored as given under Pipes*
	*Tilting Trap (Bundy)*		
	*Tilting Trap (Crane Tilt Non-Return)*	*Black*	
	*Tilting Trap (Crane Tilt Lifting)*		
	*Anchor*		
	Thermostat	*Black*	
	Vacuum Cleaning Outlet		
	*Water Level Trap*		
● ⑥ *Numerals within circles as required Large Circles 1/4" diameter*	*Steam Riser*	*Red*	*Black No's in Black circles*
○ ⑦	*Return Riser*	*Blue*	
○ V③R	*Vacuum Cleaning Riser*	*Black Numbers in Green Circles Black Letters*	
◉ R②R	*Refrigeration Riser*		
×	*First Floor Radiator Connection - Supply*	*Red*	
×	*First Floor Radiator Connection - Return*	*Blue*	
 Plan	*Radiator*	*Black-with Green Diagonal Lines*	
	*Radiator (Without Pedestals Wall-hung)*	*Black-Filled in Solid with Green*	
	*Wall Radiator*	*Black-Green Center Line or filled in solid with Green*	
 On Ceiling	*Wall Radiator*	*Black-Green Diagonal Lines*	
	Circular Radiator	*Black-Fill in solid with Green between two outer Circles*	
	*Vento Sections*	*Black-Green Diagonal Lines*	
 Elevation or Corner	*Pipe Coil*	*Black*	
 *As required* Plan	*Pipe Coil (Show Pipes if desired)*		

Discrepancies in Official Publications.

Some of the statements in a recent bulletin issued by the Bureau of Mines and entitled "Saving Fuel in Heating a House" are challenged by the *Gas Institute News.* For instance the bulletin states:

"As a fuel for residence heating, coke has the merit of cleanliness, but much of the heating apparatus in use to-day is ill adapted to burning it, and hence the obtaining of satisfactory results is rendered difficult, if not impossible."

Regarding this statement the *Gas Institute News* says:

"The redeeming feature of such statements, even from official sources, is the fact that they are so far from the truth that it would seem as if it was not necessary to contradict them. However, the institute can hardly afford to let such statements pass without giving conclusive evidence of their gross inaccuracy. The best evidence seems to be the facts in regard to the sales of coke for domestic purposes.

"It is the usual experience of gas companies making gas coke that they are able to sell all their product at a fair price without much effort. The local demand generally takes it all. A large percentage, probably over 90%, is used for cooking and heating, in appliances not especially designed for coke burning.

"The fundamental reason for this fuel being used in place of the ordinary hard coal is the fact that in a heating test of the coke compared with the ordinary hard coal sold it shows a greater heating value, due principally to a less percentage of ash.

"It is further interesting to note that in Bulletin 336, issued by the United States Geological Survey in 1898, a series of tables giving the efficiency of fuels, anthracite coal is given as 66, bituminous coal as 68, and coke 71; and in another test for standard fuels anthracite coal was placed at 49 and coke at 63.

"On page 27, of this same technical paper No. 97, there also appears this statement:

"'Coke cannot be burned in the same way as either anthracite or bituminous coal. The heater should be specially designed for burning it, or satisfactory results may not be obtained. Under a low draft *it ignites less rapidly than anthracite or bituminous coal,* and the heater should be especially designed for burning coke, or satisfactory results may not be obtained.'

"The phrase in italics stamps the production as having been written by someone with little or no experience whatever, for it is a well-known fact to all housekeepers that the relative kindling properties of various fuels are as follows: Charcoal, gas coke, bituminous coal, hard coal and hard coke.

"The large sales of coke that have been made during the last few years in our northern states by the gas companies, and the accomplishment of continued sales without the change of appliances wherein to use the coke, prove conclusively that coke can be burned in the same appliance as anthracite coal; that the heater need *not* be especially designed for burning it; that eminently satisfactory results can be obtained without changes, and that under a low draft it ignites *much more rapidly* than either anthracite or bituminous coal."

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

DISTRICT HEATING—

District Heating System at Whitby, Ont. J. Lanning. Ills. 1,500 w. Can. Engr.—Nov. 18, 1915. Heating and ventilating system for the Hospital for the Insane. 20c.

HOT WATER HEATING—

Hot Water Heating Systems. George E. Reid. Diagrams. Lecture before N. A. S. E., Washington, D. C. 3,000 w. Natl. Engr.—Nov., 1915. Philosophy of circulation. 20c.

RESEARCHES—

Notes on Some Recent Researches. J. E. Petovel. Ills. 50 pp. Manchester Assn. of Engrs.—Oct. 30, 1915. Part I. Heat transmission. Part II. Heat flow and ventilation. Part III. Gas engine research. Part IV. Strength of structures. Price on application.

SCHOOLS—

Power Plant of a Model School. R. J. Mullin. Ills. 3,500 w. Natl. Engr.—Nov., 1915. High school at Tacoma, Wash. Interesting details. Oil fuel system. 20c.

VENTILATION—

Development in Mechanical Ventilation Hygienically, Above Ground, Under Ground and Under Deck. James Keith. Ills. From a paper read before the Inst. of Marine Engrs. 1,800 w. Col. Guard.—Nov. 5, 1915. Design of ventilating systems. 40c.

◆

American Society of Mechanical Engineers.

Announcement is made that the spring meeting of the American Society of Mechanical Engineers will be held in New Orleans, April 11-14, 1916. This date is six weeks earlier than usual. Members in the east are arranging to go in two parties, one by boat and the other by train, stopping at Mammoth Cave and other points en route.

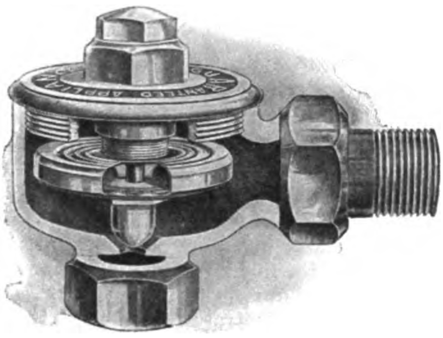
At a meeting of the society January 11, an address was given by Walter N. Polakov, superintendent of power of the New York, New Haven & Hartford Railroad, in which he demonstrated a simple method by which the owner of a power plant of any kind can, without the study of technical details, determine how closely the cost of his plant is to the possible minimum cost of such a plant.

NEW DEVICES

The Falcon Radiator Trap.

An interesting type of radiator trap, which, by the way, is the one used with the Trane vapor heating system, has been placed on the market by the Guaranteed Appliance Co., 14 East Jackson Boulevard, Chicago, Ill. It has been in actual service for several years and has been found to operate successfully on vacuum, vapor or steam heating systems, at pressures ranging from high vacuum up to 40 lbs.

This trap is made entirely of copper and the expanding member is a 2-in. diaphragm made of phosphor copper. This is filled with a sensitive liquid and in its normal position has a maximum expansion of 3-16 in.



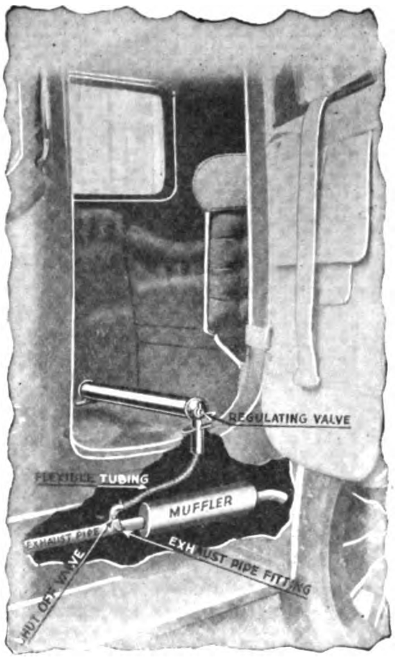
FALCON RADIATOR TRAP.

One of the features of the trap is a self-aligning stem within the diaphragm. This insures the correct seating of the plunger. Provision is also made for readjustment. The trap is self-cleaning as each discharge flushes the seat.

Normally the diaphragm is compressed. It holds the plunger from its seat and permits the free escape of air and water until steam reaches it and expands the plunger. The traps are made in ¼-in. and ½-in. sizes.

Utility Automobile Heater.

Another type of automobile heater has been brought out by the Hill Pump Valve Co., Chicago, Ill., and is illustrated herewith. It utilizes the exhaust gases from the motor to warm the interior of the car. The heater is really a radiator and foot-rest combined, and is said to keep the car heated to a comfortable temperature even in the coldest weather.



UTILITY AUTOMOBILE HEATER.

The heater itself is connected to the exhaust pipe by a flexible tube that fastens to the exhaust line just ahead of the muffler. A special fitting is provided for this purpose to fit any size of pipe. A shut-off valve is furnished to be used when it is desired to turn the heat entirely off, while a special regulating valve is located at one end of the heater for regulating the heat to any desired temperature.

Two sizes are being produced. Both types are heavily nickeled. The heater can be permanently installed in half an hour by drilling two small holes in the tonneau floor and one in the exhaust pipe, and, once in place, it costs nothing to maintain.

Electric Automobile Heater.

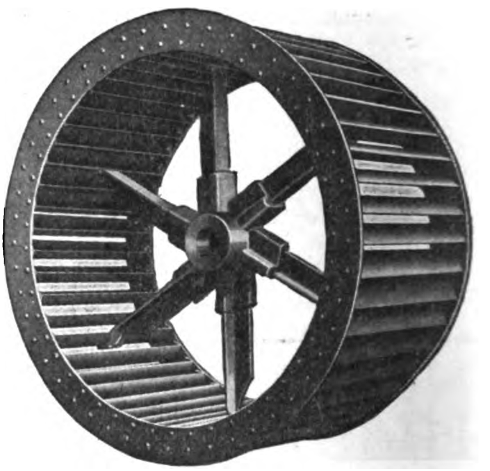
Some of the problems connected with the handling of automobiles in cold weather have been solved by a simple and compact electric heater recently placed on the market by the Hughes Electric Heating Co., 211 West Schiller Street, Chicago, Ill. This heater is shaped like a common dry cell and is about the same size. It contains a heating element that takes but 100 watts on any 110-volt lighting circuit, to which it is attached by a 10-ft. cord and plug. The shell and end caps are suitably designed to protect the element, while the shell is perforated to allow circulation of the heated air from within. The outfit weighs less than 1 lb.

HUGHES' ELECTRIC AUTOMOBILE HEATER.

When in use the heater is placed within the hood of the car, the heat generated serving to keep the vitals of the car at a uniform, safe temperature which permits starting up without delay or exertion. The cost of the heating current necessary is 1 cent or less per hour where the maximum rate is 10 cents per kilowatt hour.

Clarage Kalamazoo Multiblade Fans.

A unique type of multiblade fan, designed to handle large volumes of air with a low peripheral velocity, has been placed on the market by the Clarage Fan Co., Kalamazoo, Mich. It is known as the Clarage Kalamazoo multiblade fan. The manufacturers state that these fans have been found to equal in mechanical and volumetric efficiency and to surpass in strength and adaptability any other fan on the market. They are equipped with babbitted bearings, entirely enclosed and protected by felt washers.

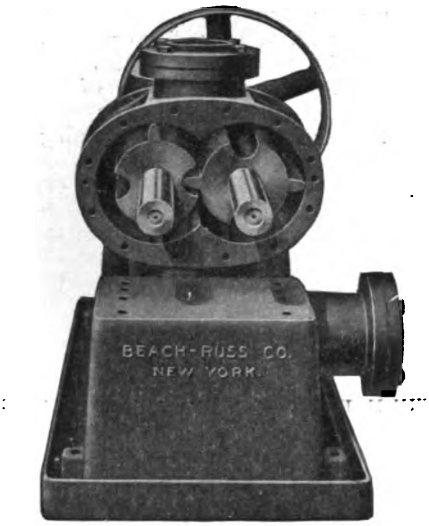


NEW CLARAGE MULTIBLADE FAN.

Among the points of interest mentioned for this fan are that the number of the fan equals the approximate diameter of the wheel in feet; that the extra large inlet area reduces friction and increases the volume of air handled; that the large outlet permits a low velocity of air travel without noise; that the shape of the blades forms a beam of great strength, considering the weight, and allows of high speed without bending, as well as permitting a center spider drive; that the center spider is an ideal arrangement, making the wheel suitable for both right and left hand housing, and allowing of the use of double inlet, single width fans, which are more efficient, while the wheel is easily kept in balance; that the wheels have 60 blades in all but the very small sizes, while the blades are riveted to heavy annular rings or rims. On large sizes a center rim and two spiders are used to give greater stiffness at high speeds. The housing details are similar in construction to those used on all Clarage steel plate fans.

Beach-Russ Return Line Vacuum Pumps.

An experience of twenty-four years in the manufacture of vacuum pumps is one of the points emphasized by the Beach-Russ Co., New York, in calling the attention of the trade to its line of return line vacuum pumps for vacuum heating systems. The accompanying illustration shows one of these pumps with the head-plate removed. It is said to be quite noiseless in operation, withdrawing the condensation and air from the radiators in a building, separating the air from the water and returning the condensation to the boiler under 10 lbs. pressure, or the condensation can be discharged into a receiving tank and then to the boiler. This pump can be applied to either new or old steam heating plants of any capacity, whether supplied from boiler or from a central heating station. The fact that the



BEACH-RUSS RETURN LINE VACUUM PUMP.

pumps have no intricate parts and have nothing to wear out is mentioned as practically disposing of the item of repairs.

The Beach-Russ Company also manufactures a full line of air line vacuum pumps, made of monel metal, which does not rust or corrode.

◆

New Publications.

Petroleum and Its Products, describing its properties, and accompanied by specifications and tables, is a recent publication (Bulletin No. 9) issued by the Kansas City Testing Laboratory, 1013 Grand Avenue, Kansas City, Mo. It sells at 25 cents a copy. The bulletin presents a summary of the production and uses of petroleum and contains useful information concerning the properties of petroleum products. One of the tables shows the cost of heating with petroleum compared with other fuels, based upon 1,000,000 B.T.U., as follows:

Petroleum..........@ $1.00 per bbl. = 0.18c.; with 80% efficiency = $0.23.
Cherokee slack coal @ $3.00 per ton = 0.13c.; with 66% efficiency = $0.20.
Natural gas @ 27c. per 1,000 cu. ft. = 0.27c.; with 80% efficiency = $0.33.
Coal gas.....@ 50c. per 1,000 cu. ft. = 0.79c.; with 80% efficiency = $1.00.
Electricity......@ 1c. per K.W. hr. = 2.93c.; with 100% efficiency = $2.93.

Colorado School of Mines Quarterly for October, 1915, contains, among other things, an article by Professor R. S. Hawley, professor of mechanical engineering, on "Systems of Heat Distribution," devoted to exhaust steam heating methods. The paper is part of a thesis on "A Treatise on Exhaust Steam Heating, with Consideration of Power Costs." The quarterly is published by the Colorado School of Mines, at Golden, Colo.

◆

Trade Literature.

The Spencer Cleaner System, featuring the Spencer turbine vacuum cleaner, is the subject of an impressive catalogue, published by the Spencer Turbine Cleaner Co., Hartford, Conn. In a foreword, attention is called to the beginnings of vacuum cleaning, the writer adding, "The misfortune of vacuum cleaning was that its possibilities were so great, its attractiveness so overwhelming, that a number of charlatans, as well as reputable manufacturers with plenty of money, but with no special knowledge or experience, rushed into the industry for the sake of its apparently great and easy profits." This, it is stated, has resulted in a large number of ambitious but unscientific devices, together with a vast amount of "atrocious" engineering. The catalogue then proceeds to discuss various methods of vacuum cleaning, such as the portable apparatus, the use of the piston type of machine, both of which are declared to be inadequate. It is then pointed out that the Spencer system does not depend alone on the use of a turbine cleaner, but also on the design and proportioning of the system itself. Numerous buildings are shown in which the Spencer system is installed, including the Woolworth Building, New York, and the Widener Memorial Library at Harvard University.

Probably the most interesting portion of the catalogue to engineers is that containing performance curves in a number of installations and the point is made that the final answer is not the vacuum maintained when first installed or for a few months thereafter but the vacuum maintained at the end of the hose after several years of continuous use. Size 8½ x 11 in. Pp. 32.

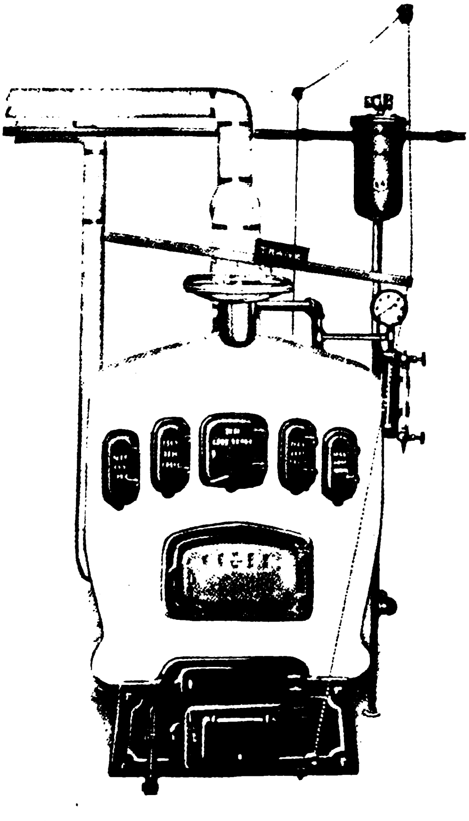
Reliable Vacuum Heating News, for January, 1916, the monthly periodical of the Bishop-Babcock-Becker Co., Cleveland, O., contains a practical article, illustrated by a diagrammatic sketch of a typical installation, on "How and Why the Reliable Return Line Vacuum Heating Equipment Provides Efficient Heating." One of the features of the *News* is its "Questions and Answers Department," relating not only to Reliable vacuum and vacu-vapor heating equipment, but to vacuum heating in general. Size 7½ x 9 in. Pp. 8.

Allis-Chalmers Centrifugal Pumps and Centrifugal Pumping Units, describing all the types of centrifugal pumps made by the Allis-Chalmers Co., Milwaukee, Wis., are dealt with in an elaborate new catalogue (Bulletin

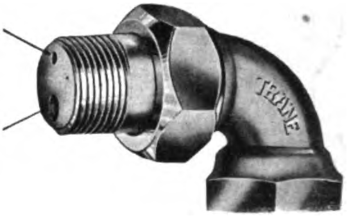
No. 1632) recently issued by the company. Size 8 x 10¾ in. Pp. 48.

Coyne National Trades Schools, Chicago, is the ttile of a catalogue issued by this institution whose courses include those on electrical engineering, plumbing, etc. The Coyne Schools have been in operation 16 years. All instruction is given by practical work with the standard tools used in the trade. Practical construction work is carried on by the students. No text-books are used, and the school does not have classes. At the same time, instruction is individual. Size 8 x 10½ in. Pp. 80.

Trane Vapor Heating System is the title of a well designed catalogue issued by the Trane Co., La Crosse, Wis. This system consists of special radiator valves, return fittings and special boiler appliances, and operates at atmospheric pressure. There is no condenser in the basement, the idea being to have the radiators furnish all the condensing effect necessary. One of the principal appliances used with the system is a sensitive vapor regulator which controls the draft so that the pressure cannot rise beyond 3 or 4 oz. In addition to the patented graduated radiator valve used, the return fitting is of unique construction. The outlet consists of two holes for air and water. The opening for water is at the bottom while the upper smaller hole is for the escape of air. It is stated that one reason why Trane systems heat up quickly is because when vapor first enters the radiators both holes are free and there is no resistance to the passage of the air which is displaced by the entering vapor. There is also a receiver used with this system which makes it possible to return water to the boiler at all times, even under a pressure of several pounds. Size 4½ x 8 in. Pp. 48.



BOILER EQUIPPED WITH TRANE HEATING SPECIALTIES.



RETURN FITTING USED WITH TRANE HEATING SYSTEM.

Finding and Stopping Waste in Modern Boiler Rooms is the title of a 68-page booklet devoted to the use and design of Cochrane meters, issued by the Harrison Safety Boiler Works, 3189 North 17th St., Philadelphia, Pa. In addition to the descriptive matter covering various types of the apparatus itself, the introductory part of the booklet takes up in detail the value of feed water and condensate meters as aids in the management of power plants. Size 6 in. x 9 in. (standard).

Clinton High Temperature Cements, which, it is stated, will resist heat better than iron, steel or fire brick, are products of the Clinton Metallic Paint Co., Clinton, N. Y., which are described in recent circulars. They include asbestos furnace cement, asbestos retort cement, asbestos putty cement and asbestos stove putty. The asbestos furnace cement is used for cementing joints and protecting iron and steel surfaces which are exposed to intense heat. This cement, it is stated, will also make absolutely tight and strong joints. It is said to be especially useful in mounting and repairing furnaces, heaters, etc.

◆

New Type of Sheet Metal Radiator.

Something new in the way of a radiator is the Pressweld "radio" alloy sheet metal for direct and indirect steam and water heating which have been brought by the American Pressweld Radiator Corporation, Detroit, Mich. This radiator is made up of uniform sections, each section consisting of two plates of heavy gauge, radio alloy sheet metal, made especially for the purpose, stamped out by presses and then united by a special welding process which, it is stated, results in a perfect steam and watertight joint.

The sections are joined by a special right hand nipple top and bottom, which is featured as the most practical connection ever made to add sections or to reduce the number of units at any time.

Among the advantages mentioned for the Pressweld radiator is that it will heat quicker, cool quicker and radiate more heat from a given surface than a cast-iron radiator because of the thinness of the metal, and the smoothness of the interior surface, permitting more rapid circulation, also wide air spaces for uniform heat distribution.

Attention is also called to the light weight of the Pressweld, which is one-fourth the weight of a cast-iron radiator of equal capacity.

The company has issued a catalogue containing full details of this line, including tapping lists, measurements and capacities.

◆

How Can Engineers Best Utilize the Technical Journals?

That we cannot keep abreast of the times without reading the engineering journals is obvious. That if we carefully read all the engineering journals in our chosen specialty we would have no time left to earn a living is easily capable of demonstration. What then is the proper attitude to adopt toward this ever increasing flood of information that pours in upon us so relentlessly, week after week, month after month, and year after year?

What shall the reader do with his special selection, from his technical journal, when once he thinks he has separated them from the flood of raw material?

Several courses are open to him:

1. He may rely on his memory and the published index to his bound volumes.

It is safe to say, however, that few engineers really make much practical use of this method. The intervening index and the bother of a search following, prove to be discouraging to that degree that a proposed reference search is abandoned in about one-half the suggested attempts. The ideal filing system is the one in which, with the least amount of effort, one can put his hand immediately and accurately on the thing itself, be it a book, a pamphlet, or a data sheet.

2. He may keep a special card index of important data, and reference to valuable articles. This at once involves labor and attention, which few busy men can give, and which, if done by assistants or librarians, largely loses its personal value to the one who needs it. The same objection as to the discouraging effect of intervening indexes holds good here, too, and it is further safe to say that of all the contrivances for indexing, the most difficult to readily handle and rapidly examine is the card Index system.

3. He may abstract important data in a limited way on loose leaf transparent paper, standard letter size, and he may remove or detach articles of special value from out his journals, to be filed in regular office file system, like correspondence.

The writer has tried all of the above methods at considerable cost in time and patience, and has, for many years, settled upon the the third method above outlined. With all its admitted limitations it seems to be the best for an office which is expected to find out information on a great variety of subjects in a limited time, and with the least amount of effort.

Some description of its practical workings may be of interest here.

All the technical papers of the office pass on to the desk of the head of the office and are at least looked over (not read) by him. Articles important to his particular specialty are checked with pencil, and articles of especial interest are looked over with care and double checked. Once in a long while data important enough to go to the data file is noted. This is either especially abstracted by the stenographer, or, if a diagram or cost data, perhaps traced in the drafting room; all on transparent paper for copying purposes. Special data of this kind on 8½ x 11 in. sheets is filed in the office data file (a separate but common standard correspondence file). From the data file loose leaf working notebooks are made up from blue prints for office or travel purposes. They are altered, refilled, amended, and sorted back from time to time as needed to keep them of usable volume and usefully up to date.—*John W. Alvord before the Federation of Trade Press Associations.*

◆

Talking Points for Better Heating Installations.

The question of heating our homes, though one of the most important items which enter into the general scheme of successful house design, is the one which is most frequently neglected. We are particular to have the architectural details worked out to conform to our ideas—and we generally have ideas about almost everything except the heating of the home, but when it comes to the heating, all we, consider is the first cost. We install the cheapest system we think we can get along with, and the lowest bidder gets the job. Now this is all wrong. The external appearance of the house, the arrangement or rooms, halls and closets, the interior decorations, the selection of lighting fixtures, etc., are all important elements in the designing of a house, but do any or all of these affect the health or happiness of the occupants nearly so directly as the system of heating which is to be installed? Couldn't we much more easily put up with changes in some of those items which would prevent them from conforming exactly to our ideas, than we could put up with a poor or inadequate system of heating? For more than half of the year we need artificial heat in our homes, and those of you who have lived in poorly heated houses know that nothing is so great a hardship to a family as the lack of proper heating arrangements.

We also, in designing our homes, consider very seriously the question of maintenance in almost everything except the heating. We endeavor to make the house and its furnishings as durable as possible in order to reduce the cost of maintenance; but the heating system is seldom included in this scheme of after economy. More often the lowest first cost of installation is what the owner considers. In such cases he subsequently pays for fuel poorly utilized—many times the saving in first cost of installation, besides not obtaining the desired heating results. It would be better and more profitable to install an efficient, durable, and above all, an adequated heating system, which would save fuel and annoyance every day that the house has to be heated.—*Roy E. Lynd, before the Borough Club of Tenafly, N. J.*

◆

Handy Hot Water Tank Regulator.

A handy hot water tank regulator, by which the amount of coil surface in iron pipe and in brass pipe, as well as the pounds of condensation per hour, may be quickly figured, is being sent out by the Powers Regulator Co., Chicago, Ill., with its compliments and New Year's wishes. The calculator is of celluloid with a superimposed separate disc. By moving the upper disc around in the desired direction until the various figures involved register, the result is read directly from the calculator.

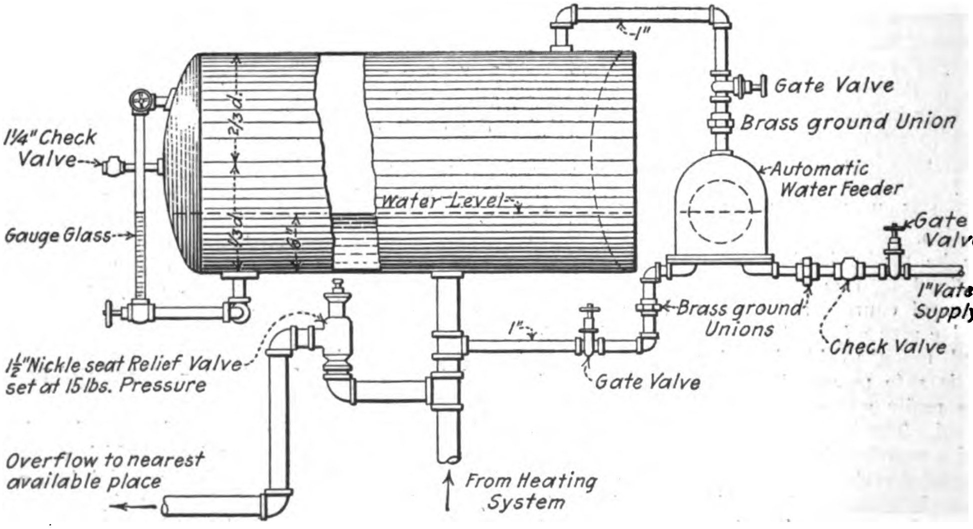
◆

Expansion Tank Data for Hot Water Heating Systems.

The following tables, useful in connection with computing the sizes of expansion tanks required in hot water heating systems, give the number U. S. gallons of water in round tanks of variable diameters and depths, and in one foot of wrought iron pipe for various sizes.

One square foot of cast-iron direct or indirect radiation contains 0.1875 U. S. gals. The usual temperature rise allowed in hot water heating systems is from 60° to 220° F., or an increase of 3.8% of all the water in the system. In installations of small capacity, an allowance of 5% is necessary.

In computing the required capacity of a tank, due allowance should also be made



TYPICAL EXPANSION TANK DETAIL.

EXPANSION TANK DATA.

U. S. Gallons of Water Per Foot of Wrought Iron Pipe.

Size.	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	10	12	14	16
U. S. Gals.	.045	.078	.106	.174	.249	.384	.514	.662	.83	1.04	1.5	2.02	2.6	4.1	5.88	8.3	11.0

U. S. Gallons Contained in Round Tanks.

	Diameter in Feet.										
Depth, ft.	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
2	12	26	47	73	106	144	188	238	294	355	423
2.5	15	33	59	92	132	180	235	297	367	444	529
3	18	40	71	110	159	216	282	357	441	533	635
3.5	21	46	82	129	185	252	329	416	514	622	740
4	24	53	94	147	212	288	376	476	588	711	846
4.5	26	60	106	165	238	324	424	535	661	800	952
5	29	66	117	184	265	360	480	595	734	889	1,060
6.5	35	79	141	221	318	432	564	714	870	1,066	1,270
7	41	93	165	258	371	504	658	833	1,015	1,244	1,480
8	47	106	188	294	424	572	752	952	1,160	1,411	1,690
9	53	119	212	235	477	644	846	1,070	1,305	1,600	1,900
10	59	132	235	372	530	716	940	1,190	1,450	1,777	2,110

for the cold water level to show in the guage glass at a height 6 in. above the bottom of the tank, as shown in the expansion tank detail.

In the detail a tank is shown connected to an automatic water feeder which maintains a minimum water line. The supply is through a gate, then a check valve. An equalizing pipe and pipe inlet to tank, each with a gate valve, is provided, as shown. A 1½ in. nickel seat relief valve, set at 15 lbs. pressure, provides the necessary relief for high pressures. The overflow is run to the nearest available place and the water from the heating system enters as shown. The guage glass is equipped with shut-off valves.

◆

Correct and Incorrect Methods of Connecting Branches to Main Ducts.

The proper manner in which to connect the branches of a ventilating system to the main or trunk duct for the conditions shown is illustrated by Figs. 1 and 2, in which the dotted lines indicate the more usual, but incorrect, way.

A connection made as shown in dotted lines in Fig. 1 would require the use of a volume damper in order to throttle the air supply, as this connection is in direct line with the main travel of the air in the trunk duct. While this could be readily accomplished, it would be objectionable, due to the noise caused by a high velocity, and would be undesirable particularly if installed in a schoolhouse, where quietness of operation is required. The full lines indicate the more advisable method, though this would serve to decrease the amount of air supplied to the connection. However, the apparent disadvantage may be overcome by the partial closing of the dampers at all connections beyond. Furthermore, the tendency for the main travel of the air is to follow the outer circle of the main duct, as shown by the arrows.

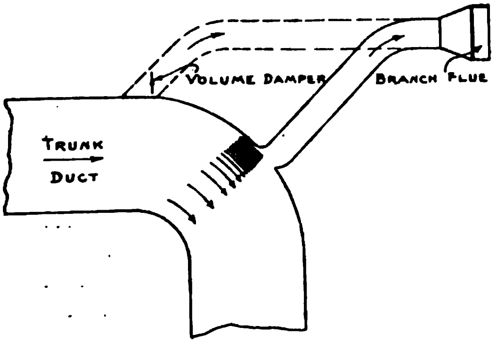


FIG. 1.—CORRECT AND INCORRECT LOCATION OF BRANCH CONNECTION.

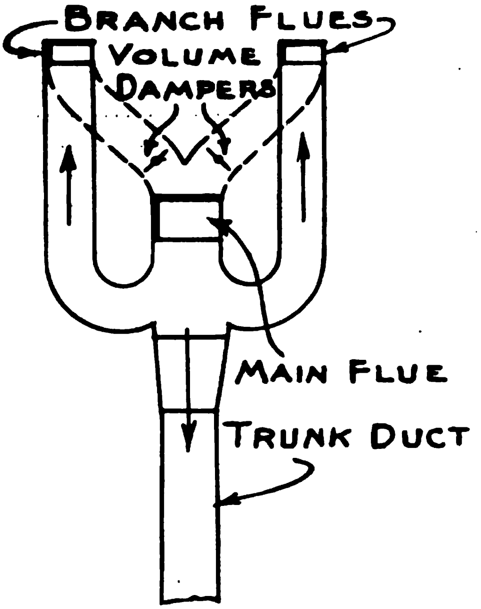


FIG. 2.—SUPPLYING AIR FROM MAIN TO BRANCH FLUES.

A somewhat similar case is shown in Fig. 2. In this instance, the supply of air to the two flues would be too great, due to the slight resistance set up by their short connections to the main flue, especially when compared to the longer run to the flues further on. Otherwise the remarks applying to Fig. 1 are of equal force.

◆

Gold Medal for Cochrane Metering Heater.

An award of the gold medal was given the Harrison Safety Boiler Works, Philadelphia, for its exhibit of the combined open-feed water heaters and hot water meters, known as the Cochrane metering heater, exhibited at the Panama-Pacific International Exposition in San Francisco. This apparatus is designed to heat boiler feed water by means of exhaust steam from engines, pumps, etc., and simultaneously to meter the water and record the rate of flow, and to integrate the total flow in any elapsed period.

◆

Year Book of New York Chapter of Heating Engineers.

The New York Chapter's Year Book for 1915-1916 has been published in vest-pocket size. It contains the officers, committees, constitution and by-laws, as well as the papers read at different times before the chapter since its organization in 1911. The list of members given is corrected up to January 1, 1916. The chapter has 75 members in all classes.

◆

Herbert Coward, for three years in charge of the Spiro turbine department of the Buffalo Forge Co., has been appointed steam engineer of the Carrier Engineering Corporation, of New York.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MARCH, 1916

Pipe Hangers

METHODS OF ARRANGING AND DETERMINING STRENGTH OF VARIOUS TYPES OF SUPPORTS

BY HAROLD L. ALT.

I.

The science of pipe hanging is often neglected on smaller-sized jobs, but in larger work must be carefully considered. This is especially true where the pipes are either large or numerous and must be supported in a neat, substantial manner with allowance for individual adjustment, expansion, etc.

How to accomplish this in the cheapest satisfactory manner for certain cases is illustrated in this article and the reader may rest assured that while it may be possible to support a pipe in a cheaper manner, it will not be as satisfactory as the hangers and supports shown, which are standard as adopted by the foremost engineering and power organizations in this country.

FIGURING STRENGTH OF U BOLTS.

The support of horizontal pipe generally develops into a U-bolt type of hanger. Examples and methods of figuring strength for same are shown in the following:

In Fig. 1 is shown a hanger carrying three pipes which may all be assumed as full of water. If hangers are, say, 10 ft. apart, each U-bolt carries 10 lineal feet of pipe or a load of ten times 16 lbs. or 160 lbs. for 4-in. pipe; 10 times 23 lbs. or 230 lbs. for 5-in. pipe; ten times 31 lbs. or 310 lbs. for 6-in. pipe.

If U-bolts are figured at lower stress per square inch on account of part of metal being cut away in threading the ends, 8,000 lbs. is a good safe figure to use. Even at this low mark a ½-in. bolt will carry ½ x ½ x 0.7854 x 8,000, or roughly 1,500 lbs. and when bent in U-shape it will carry twice as much or 3,000 lbs. load. This shows that a ½-in. U-bolt would carry ten times as much 6-in. pipe as we have in the case under consideration, thirteen times as much 5-inch pipe and nineteen times as much 4-in. pipe.

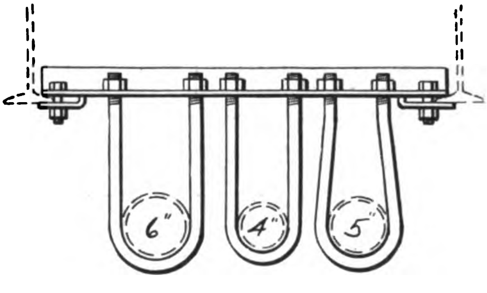


FIG. 1.—U-BOLT TYPES OF HANGERS.

These pipes being spread along the whole length of the angle practically constitute a distributed load so that the bending moment is WL divided by 8, when W is the total weight of the pipes and L the length in inches of the angle, or, say, 5 ft. Then WL is (160 + 230 + 310) x 60 = 700 x 60, or 42,000 in lbs. 42,000

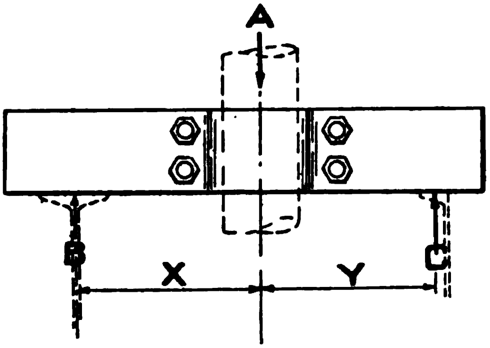


FIG. 2.—SUPPORT FOR VERTICAL PIPE.

divided by 12,000 lbs. stress equals 3.5 sectional modulus.

As can be found in any steel catalog 4-in.—5.25 lb. channel has a sectional modulus of 1.9 and, therefore, two of these will give a combined modulus of 3.8. This shows that the angle given in the figure should not be used since channels are always more economical in material for the same strength and the two 4-in. channels in this case should be substituted.

DETERMINING REQUIRED STRENGTH OF HANGERS FOR VERTICAL PIPES.

Let us see how to determine the required strength of a few types of hangers for use on vertical pipes. In Fig. 2 is shown a support for a vertical pipe which rests on two steel members. When the weight of pipe is 2,000 lbs. pressing down at A, the load on beams at B and C will be approximately ½ of 2,000 lbs. or 1,000 lbs. each. Then the bending moment is that for a simple beam with a concentrated load, or WL divided by 4. W is weight of pipe and L, length of span in inches (X plus Y) which we will assume as about 3 ft. in this case. Then the bending moment equals 2,000 × 36 divided by 4, or 18,000 in. lbs. If the working stress in metal is kept down to, say, 12,000 lbs. per square inch, the sectional modulus required will be 18,000 divided by 12,000 or 1.5.

Now that we know the sectional modulus required, it only remains to find the shape which has an equal or greater sectional modulus. The construction of this hanger requires the use of flat iron in two pieces and in order to get in two bolts side by side the height must be 5 in. or 6 in. This leaves us to determine the thickness only. Now this piece of flat iron, having its two dimensions different, is rectangle in cross section, the height of the rectangle being, say, 5 in. and its width (or thickness of metal) yet to be determined. The sectional modulus of any rectangle is obtained by multiplying the breadth by the square of the height and dividing by 6. Knowing the heigth (5 in.) already we have breadth x 5 x 5 divided by 6 = sectional modulus, or

Breadth x 5 x 5 divided by 6 = 1.5.
Breadth x 25 divided by 6 = 1.5.
25 x breadth = 1.5 x 6.
25 x breadth = 9.
Breadth = 0.36 in. or 3/8-in.

This total breadth is for two pieces, each piece being only half as thick, or 3/16-in. In actual practice, however, these would probably be made 3/8-in. thick each and certainly not less than ¼-in.

CANTILEVER BEAM HANGERS.

In Fig. 3 is shown a clamp that is supported on one side only, forming what is known as a cantilever beam. The bending moment is obtained here from the cantilever beam formula which is WL, when W is load of pipe and L distance X from the center line of pipe to the center line of beam or support. Actually it is quite likely that distance L should only extend from the center line of the pipe as far as F, instead of way over

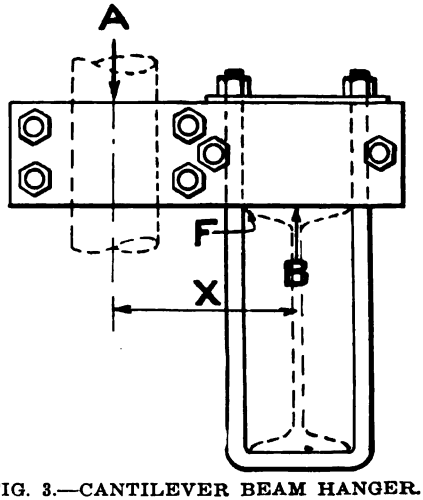


FIG. 3.—CANTILEVER BEAM HANGER.

to the center line of beam, but this error, if present, is on the side of safety and need not be seriously considered. If the pipe load in this case is 3,000 lbs. and the distance X, say, 24 in., then WL equals 3,000 x 24 in., or 72,000-in lbs. and 72,000 divided by 12,000 = 6 required sectional modulus. Then, by methods similar to those already employed, we assume that our rectangular piece of flat is 5-in. high and solve as follows:

$$\frac{\text{Breadth} \times 5 \times 5}{6} = 6$$

$$\text{Breadth} = \frac{6}{25} \times 6$$

$$\text{Breadth} = \frac{36}{25} \text{ or } 1.44 \text{ in. width required.}$$

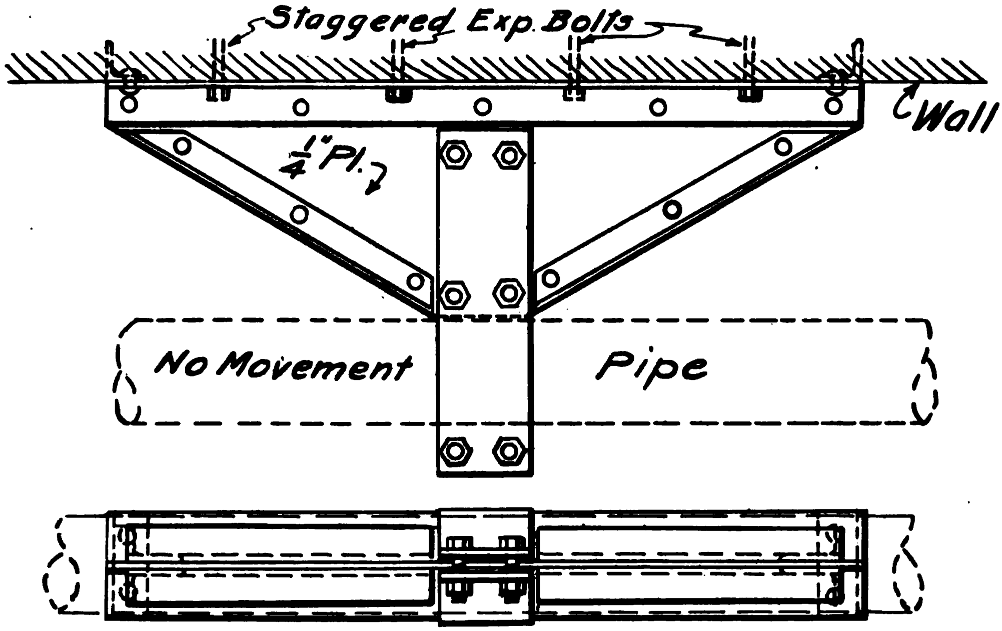


FIG. 4.—PIPE ANCHOR FOR USE NEAR MASONRY WALLS.

Half of this thickness in each piece of clamp would give ¾-in. metal, which is pretty heavy to bend, so we might try the figuring over again, using a flat 6-in. wide (high). Then our rectangle sectional modulus is

$$\frac{\text{Breadth} \times 6 \times 6}{6} = \text{regular sectional modulus of } 6.$$

$$\text{Breadth} \times 6 = 6.$$

$$\text{Breadth} = 1.$$

or each flat is ½-in. thick which is much better.

To find size of U-bolt we have to note that the tendency of the hanger when carrying its pipe is to turn around point F. The U-bolt prevents this, but only with the rear leg; the other leg at F is neutral as far as this turning motion is concerned. Again, in figuring U-bolts we consider the centre line of beam rather than point F and again the error (if any) is on the side of safety. The load exerted on the rear leg of the U-bolt is found by multiplying the pipe load by its distance from the turning centre B and dividing by distance from turning center B to leg of bolt. If the pipe is 24 ins. from beam and the U-bolt leg only 4 ins., then the force exerted on the rear leg of

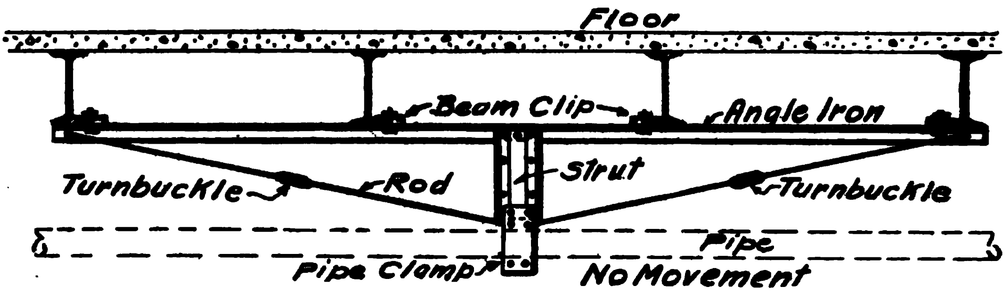


FIG. 5.—PIPE ANCHOR FOR USE UNDER FLOOR BEAMS.

U is pipe load multiplied by 24 and divided by 4 which is

3,000 x 24 divided by 4 = 18,000 lbs.

Allowing 8,000 lbs. per square inch stress in leg of bolt we have an area required of 18,000 divided by 8,000, or 2.25 sq. ins., which is the area of a bolt 1¾ in. diameter. This size bolt is out of the question so that we must either move our pipe in to, say, 12 ins. or use a different method of support. If we move it in to 12 ins. from center line of beam we have

3,000 x 12 divided by 4 = 9,000 lbs.

9,000 divided by 8,000 = 1.12 sq. in. area, or 1¼ in. bolt, which is not so bad.

This also allows us to cut down the size of the flat iron employed in the clamp as follows:

Breadth x 5 x 5 = 3,000 x 12 divided by 12,000.

$$\frac{25 \text{ x breadth}}{6} = 3.$$

$$25 \text{ x breadth} = 18$$

$$\text{breadth} = \frac{18}{25}$$ equals 0.72 in. total thickness or ⅜-in. for each piece.

FIGURING PIPE ANCHORS.

When it is desired to anchor pipe figuring is not so easy, owing to fact that no one seems yet to have devised a method whereby the stress thrown onto the anchor can be determined. If the force that pipe will exert is known, it is comparatively easy to figure sizes on the anchor itself.

Owing to this uncertainty anchors are usually designed even more conservatively than pipe hangers and for all pipes of large size are generally made heavy enough so that the pipe can't get away without taking the building (or whatever the anchor is fastened to) along with it. Fig. 4 shows a good solid type of anchor often employed where pipes run near masonry walls. When properly put up it gives good satisfaction. The reason for putting angle clips on the back is to get a good bearing on wall without depending on the bolts to prevent sliding. Oftentimes without these clips the force tending to move the anchor is sufficient to crush the brick or mortar immediately behind the bolts, thus dangerously loosening the anchor.

One good type of anchor for cases where pipes run under floor beams is shown in Fig. 5. Movement in either direction is resisted by two beams and the placing of *two* beam clips on each beam would result in all four beams getting the load. A strut in the middle prevents the pipe being raised when turnbuckles are

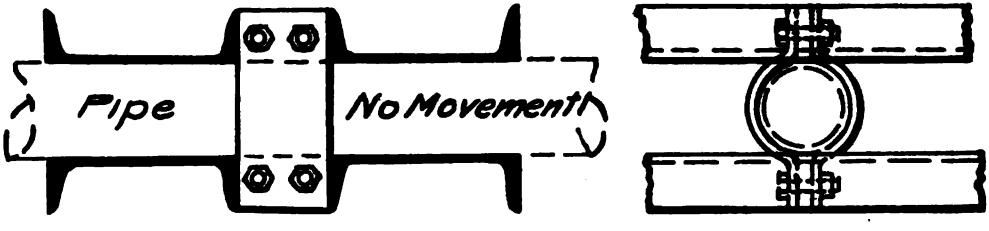


FIG. 6.—ANCHOR DESIGNED ESPECIALLY FOR USE IN PIPE TUNNELS AND TRENCHES.

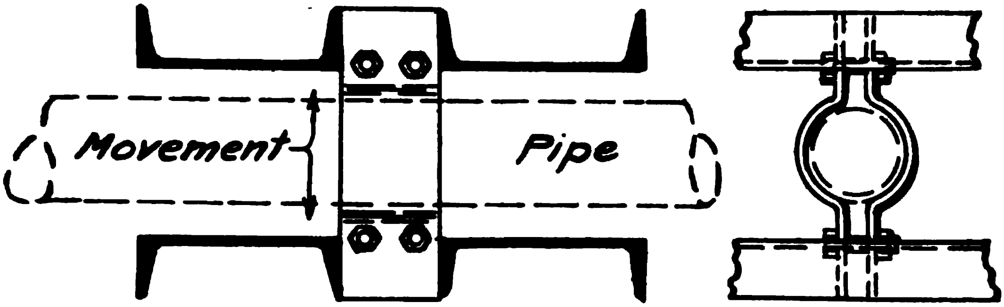


FIG. 7.—ARRANGEMENT OF ANCHOR TO PREVENT BACKWARD OR FORWARD MOVEMENT OF PIPE.

tightened, and turnbuckles and rods give this anchor great tautness and rigidity without any twisting tendency.

In Fig. 6 is shown a type of anchor often used in pipe tunnels and trenches where cross channels can be set in masonry on each side of the pipe. If, by any possibility, a lateral movement of pipe has to be taken care of, provision is made for so doing by an arrangement such as is shown in Fig. 7, where the pipe is free to move up or down, but neither backward nor forward.

A typical example of the concrete application of the foregoing abstract rules and calculations will be found in Fig. 8. Here we have a pipe coming in near the basement floor, rising up to the first floor ceiling and running along the ceiling beams. Owing to the pipe being anchored farther back we have some expansion to take care of at point No. 4 and also expansion in two different directions (as shown by the arrows) at point No. 3. Risers can be hung in three ways:—at bottom, at top, and at points between, if

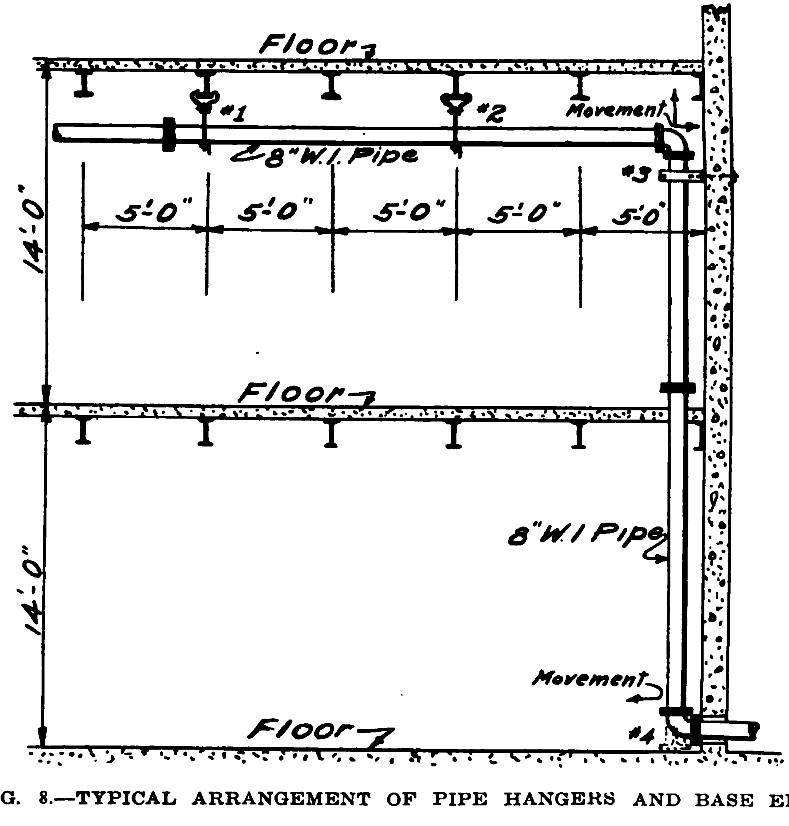


FIG. 8.—TYPICAL ARRANGEMENT OF PIPE HANGERS AND BASE ELL.

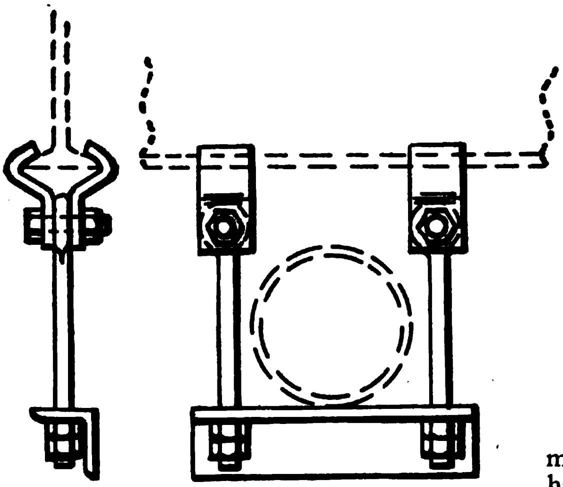


FIG. 9.—DETAIL OF HANGERS NOS. 1, 2, 5 AND 6.

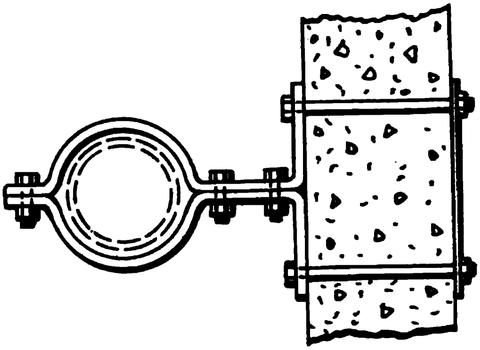


FIG. 10.—PIPE GUIDE PERMITTING EXPANSION AND CONTRACTION.

expansion joints or loops are provided. As there is no provision for expansion here, suppose we try supporting the riser at the bottom. The easiest way to do this would be to insert a base ell at point No. 4 (as shown in dotted lines) and to put rollers under foot to allow for expansion movement. Then at point No. 3 we should have to leave pipe free to move up and down on account of the expansion in the riser between base ell (which is a fixed point) and point No. 3. A guide consisting of simple clamp made about ½-in. larger than the pipe, as shown in Fig. 10, will answer every purpose at this point, and at points Nos. 1 and 2 hanger, as shown in detail in Fig. 9, can well be used.

(*To be Continued.*)

New Empirical Formulae for Hot Water Heating

With Pipe Sizes for Two-Pipe Systems:

By Jay H. Keller.

The subject of hot water heating is the least known scientifically, among the general trade, of any of the branches of heating, and is the most difficult system to make operate successfully. Most of the contractors and some engineers have a hit-or-miss system for sizing the pipes which general experience through years of practice has finally boiled down to fairly successful operation, although the reason for the use of certain size mains, branches, valves, etc., is never clearly known. The only knowledge possessed is that the system works better under certain conditions and if certain size piping is used.

There is no hit-or-miss rule for governing the laws of Nature. They can be placed on a definite scientific basis of figuring, and the sizing of pipes for hot water heating is purely the result of a knowledge of the laws of gravity.

If all the mains, branches, valves, etc., in a system of gravity hot water heating were sized in proportion to each other, in accordance with the amount of radiation they handled, the sizes not being ridiculously small, and the supply and return mains so reversed that the length of pipe to each heating unit was the same, good results could be gotten without much figuring.

For the benefit of the trade and the profession, I would like to offer the accompanying tables and the following explanation of how they were derived. The coefficients used were mostly derived by the author through years of experiments and tests, but the details of these tests will not be gone into except in a general way.

First to find the amount of water to be supplied to each foot of radiation per hour:

C = cubic feet of water per hour per square foot of radiation.

K = coefficient of transmission of cast-iron radiating surface.

T = mean temperature of water through radiators.

t = temperature of room.

t′ = drop in temperature of water through radiator.

W = weight of one cubic foot of water at mean temperature through radiator.

$$C = \frac{K\,(T-t)}{t'\,W}$$

The loss of heat from the water during its transmission from the boiler to the radiator and from the radiator back to the boiler was found by the following method:

T′ = temperature of water leaving boiler.

T″ = Final temperature of water at radiator inlet.

T″–t′ = temperature of water leaving radiator.

T ‴ = final temperature of water entering boiler.

K = coefficient of transmission for pipe covering.

L = length of pipe in feet.

R = outside diameter of pipe in inches, divided by 2.

T ⁗ = temperature of air around pipe covering.

$$T'' = \frac{12\,(T' - T'''')\,K'\,L\,t'}{\pi\,R^2\,K\,(T - t)}$$

$$T''' = \frac{12\,[(T'' - t') - T'''']\,K'\,L\,t'}{\pi\,R^2\,K\,(T - t)}$$

$$= \frac{12\,K'\,L\,t'\left\{\left[\left(\frac{12\,(T' - T'''')\,K'\,L\,t'}{\pi\,R^2\,K\,(T - t)}\right) - t'\right] - T''''\right\}}{\pi\,R^2\,K\,(T - t)}$$

The force causing the flow of water to the heating unit is the natural force of gravity, the radiator cooling the water which causes a difference in weight. The cooler water, being the heavier, falls, and the warmer water rises. The head causing this motion of the water is the head equal to the difference in weight between the two columns of water. Thus:

h = height in feet above the return opening in boiler.

W′ = weight of one cubic foot of water at $\frac{T' + T''}{2}$ temperature.

W″ = weight of one cubic foot of water at $\frac{[(T'' - t) + T''']}{2}$ temperature.

H = total head.

H ″ = velocity head.

H ′ = friction head.

g = force of gravity (32.16).

d = diameter of the pipe in inches.

V = velocity of feet per second.

Using the formula by William Cox: which is close enough for all practical purposes and does not necessitate the use of complicated mathematical formulæ, we have the following:

$$V = \sqrt{2\,g\,H''}$$

$$H'' = 2\,V^2\,g$$

$$H = H' + H''$$

$$H' = \frac{L}{d}\,\frac{4\,V^2 + 5\,V - 2}{1200}$$

$$H = \frac{L}{d}\,\frac{4\,V^2 + 5\,V - 2}{1200} + 2\,V^2\,g$$

$$4\,V^2\,L + 5\,V\,L + 2400\,V^2\,g = 1200\,d\,H - 2\,L$$

$$H = \frac{h\,(W' - W'')^2}{288}$$

As all the other quantities are known, solve for V.

After finding the velocity, to find the amount of radiation that an assumed pipe will carry, I used the following:

S = amount of radiation in square feet.

$$S = \frac{36\,V}{6.545\,d\,C}$$

As the amount of radiation varies greatly between standard sizes of pipes, some arrangement must be made so as to only allow the correct amount of water to each radiator and to prevent short-circuiting. This is best obtained by installing copper discs, with holes bored in the center, in the unions of either the valve or the ell on the radiator.

To find the desired size of the orifice through the disc I used the following:

d′ = diameter in inches of the orifice through disc.

$$d' = 12\sqrt{\frac{C}{2572.92\,V}}$$

To find the size of the orifice through the disc without working back through the long series of equations, use the table and the following equation:

S = the desired amount of radiation.

S′ = the maximum amount of radiation that the pipe used will carry.

d = diameter of the pipe in inches.

d′ = diameter of the orifice in inches.

$$d' = 1.1\sqrt{\frac{Sd^2}{S'}}$$

For instance, we have 60 sq. ft. of radiation on the second floor, 100 ft. run of pipe, what size orifice in the disc?

The nearest size pipe in the table would be 1-in. and would carry 84 sq. ft. of radiation.

Then S. = 60
S′. = 84
d. = 1

$$d' = 1.1\sqrt{\frac{60+1^2}{80}}$$

= 0.942 in.

The constants used for the accompanying tables were as follows:

K = 1.62 B.T.U. (for two column 38-in. cast-iron radiation set against a cold brick wall near a window, average conditions.)
(one coat of bronze paint.)

K = 0.87 B.T.U. (3-ply asbestos air-cell covering and 5 oz. canvas jacket, no paint.)

The coefficient of discharge through the orifice in the equalizing discs was obtained by experiments and found to be 0.91. The metal used in the disc was annealed copper, 22 gauge.

RADIATION TABLE FOR TWO-PIPE GRAVITY CIRCULATION HOT WATER HEATING.

Boiler temp., 180° F. Temperature drop, 20° F. Piping figured as being covered with 3-ply air cell, 38-in. 2-col. radiators.

Distance from Top of Boiler to Floor.

Diameter of Pipe, Inches.	4 Ft. Above Boiler. Length of Run, Feet.					14 Ft. Above Boiler. Length of Run, Feet.				
	25	50	100	150	200	25	50	100	150	200
¾	60	40	28	24	18	103	60	40	34	27
1	84	56	38	32	26	210	130	84	70	56
1¼	206	136	97	81	64	375	245	162	135	108
1½	320	219	148	128	106	550	380	250	208	166
2	650	430	290	244	192	1,060	730	485	404	322
2½	1,080	620	420	352	280	1,730	1,200	820	683	546
3	1,900	1,300	908	754	598	3,000	2,000	1,300	1,080	860
3½	2,730	1,850	1,252	1,045	830	4,350	2,965	2,010	1,680	1,340
4	3,840	2,650	1,760	1,466	1,170	6,150	4,080	2,780	2,315	1,850
4½	5,150	3,480	2,320	1,936	1,550	8,170	5,560	3,700	3,080	2,460
5	6,850	4,640	3,160	2,630	2,100	11,100	7,350	5,000	4,165	3,330
6	11,200	7,400	5,000	4,170	3,330	17,350	11,700	7,800	6,500	5,200

RADIATION TABLE FOR TWO-PIPE GRAVITY CIRCULATION HOT WATER HEATING.

Boiler temp., 180° F. Temperature drop, 20° F. Piping figured as being covered with 3-ply air cell. 38-in., 2-col. radiators.

	Distance from Top of Boiler to Floor.							
Diameter of Pipe, Inches	24 Ft. Above Boiler. Length of Run, Feet.				34 Ft. Above Boiler. Length of Run, Feet.			
	50	100	150	200	50	100	150	200
¾	72	48	40	32	98	60	50	40
1	160	108	90	72	198	132	110	88
1¼	300	202	168	134	369	246	203	160
1½	[illegible]80	320	262	213	570	380	315	250
2	940	640	530	426	1,020	750	625	500
2½	1,510	1,030	840	650	1,800	1,210	1,005	800
3	2,570	1,750	1,455	1,160	3,090	2,060	1,720	1,380
3½	3.820	2,560	2,130	1,700	4,590	3,060	2,530	2,000
4	5,280	3,560	2,960	2,360	6,360	4,240	3,520	2,800
4½	7,260	4,780	3,960	3,180	8,500	5,700	4,750	3,800
5	9,500	6,380	5,315	4,250	11,240	7,520	6,260	5,000
6	15,100	10,000	8,300	6,600	19,200	12,800	10,500	8,200

House Heating By Gas

WITH YEARLY OPERATING COSTS IN FORTY-SEVEN BUILDINGS USING NATURAL GAS

BY F. R. HUTCHINSON.

(Presented at a recent meeting of the Cleveland Engineering Society.)

Wouldn't it be nice to say to the skeptic: "We'll guarantee to heat your house next winter for the entire heating season on a consumption of less than 10 cu. ft. of natural gas for each cubic foot of space in your home? Tell us the width of your house. You say it is 28 x 30 x 20 ft. That totals 16,800 cu. ft. and will equal a gas consumption of 168,000 cu. ft. for the season, which, if figured at 30 cents per 1000 cu. ft. for the season, will cost you $50.40."

There are thousands of householders who would jump at the offer if made. Many of them are hard, or next to impossible, to convince by facts and figures gathered from their neighbors' homes who use gas, because of some unsatisfactory experience had, through careless operation or improper installation (usually the former) by a friend or relative.

It would be foolish for any gas company to make an offer of this kind, for no care would be exercised in the operation of the valves. That it can be done, however, is shown in the general summary (Table 8) following, which records actual gas consumption, where gas was metered separately to some 47 houses or apartments in Cleveland during the winter of 1914-1915, from the opening of the heating to April 14 or 15 of 1915. This consumption represents the average amount of gas used through six different makes of gas-designed steam, vapor, hot water and warm air boilers and furnaces and many kinds of coal-designed steam, vapor, hot water and warm air boilers and furnaces with gas burners installed.

Previous to the opening of the heating season, in the Fall of 1914, we secured permission to and installed 53 submeters in as many homes and buildings to separately measure the gas supplied to an equal number of gas-heating boilers and furnaces. We had been groping around in the dark regarding the actual average gas consumption of various kinds of gas househeating appliances.

VARIOUS TYPES OF INSTALLATION TESTED.

Without regard to previous consumption, for many of these installations are new, we prepared a list of some of each kind of house-heating installations to secure these records from and set these sub or secondary meters to measure the gas consumed through the following kinds of installations, varying the size of homes and buildings heated as much as possible in scattered sections of the city to secure as nearly a true average as possible:

11—Gas Designed Steam Boilers.
2—Gas Designed Vapor Boilers.
5—Coal Designed Steam Boilers (with gas burners).
4—Coal Designed Vapor Boilers (with gas burners).
16—Gas Designed Water Boilers.
3.—Gas Designed Tank Water Heaters.
4—Coal Designed Water Boilers (with gas burners).
4—Gas Designed Warm Air Furnaces.
4—Coal Designed Warm Air Furnaces (with gas burners).
—
53

We have no knowledge of the manner in which these appliances were operated. Care may or may not have been exercised. The figures gathered are correct and reported exactly as found.

No. 1. Large building on corner and three houses on side street. Exposure moderate. Buildings of brick.

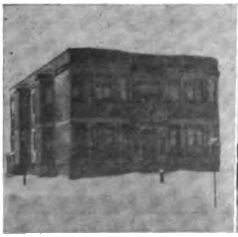
No. 10. Brick and frame building, 28 x 30 x 20 ft. Eight rooms. Moderate exposure. 70° F. maintained.

No. 2. Cement house, eight rooms and bath. Moderate exposnre.

No. 3. Frame house, eleven rooms and two baths. Boiler equipped with heat regulators set for 70° F. during day and 60° F. during night.

No. 6. Brick building, 56 x 43 x 40 ft. Two boilers. Three sides exposed.

No. 4. Four-story brick building, 85 x 40 ft. Moderate exposure.



No. 7. Four-family frame house, 73 x 48 x 20 ft. Each suite has five rooms, bath and hall. 70° F. maintained day and night. Owner provides heat for tenants.

No. 5. Four-family brick apartment, 36 x 60 x 20 ft., two stories. Four boilers. Each apartment contains six rooms. Exposure moderate. Apartment No. 3 maintains 80° F., the others 70° F.

No. 8. Frame house, 36 x 50 x 18 ft. Seven rooms and bath. 74° F. maintained. Exposure moderate.

No. 9. Frame house, 30 x 30 x 18 ft. Extreme exposure. 70° F. maintained.

These averages may not represent the general average of all house heating because of the comparatively few installations reported on.

Most of the figures seem consistent, however, except possibly in the totals for gas designed vapor heating where information was gathered from but two homes and seems very high as compared with gas designed steam heating, per hundred cubic feet of contents. Nothing has been omitted and records are reported as found in order to show the good with the bad, even though they may look inconsistent.

CUBICAL CONTENTS AS A BASIS FOR DETERMINING HEATING COSTS.

In my opinion there is but one way to determine cost for heating and that is upon the cubical contents of space to be heated. Radiation doesn't mean anything, for a home or building may be over or under radiated. Various forms of figuring radiation are employed and desires of owners to be considered. An owner constructing buildings or homes for investment seldom installs more radiation than actually necessary. A man erecting a home for comfort may play safe and furnish half as many more radiators as needed.

This may explain in part the wide difference between the minimum and maximum consumption in each classification in tables. Exposure and glass surface also play an important part, both in consumption per square foot of radiation and per cubic foot of contents.

Tables 1 to 8, inclusive, report details and summaries of all sub-meters. For the purpose of more nearly ascertaining a true average for house heating, several of the large buildings included in the totals of Table 8 were omitted in Table 9. *All the figures used in tables shown are based on natural gas sold at 30 cents per 1,000 cu. ft.*

The United States Weather Bureau reports average temperatures from November 1, 1914, to April 15, 1915, as follows:

	Deg. F.
November	41.9
December	27.0
January	26.0
February	32.8
March	30.4
April (to April 15)	42.0

We have assumed that April 15 closes the heating season. Some gas may have been used after that date for heating, but no great quantity, and it is pretty safe to assume these figures to be correct for an average season in our climate (Cleveland, O.)

ANALYSIS OF FIGURES.

A wide difference is represented between the minimum consumption 327 cu. ft., and the maximum consumption, 1,160 cu. ft. of gas per 100 cu. ft. of

TABLE 1.—STEAM AND VAPOR GAS HEATING.—GAS-DESIGNED BOILERS.

Steam.

No. of Building.	Contents, Cu. Ft.	Sq. Ft. of Radiation.	Cost per Season.	Season's Cost per Sq. Ft. of Radiation.	Season's Consumption per Sq. Ft. of Radiation, Cu. Ft.
1	345,384	5,200	$510.51	$0.0981	327
2	15,336	634	81.57	0.1287	429
3	25,900	757	98.82	0.1305	435
4	940,000	1,726	294.90	0.1710	570
5	43,200	640	112.95	0.1766	588
6	96,320	2,189	494.76	0.2259	753
7	64,872	487	159.15	0.3267	1,089
8	32,400	244	84.90	0.3480	1,160
	1,563,412	11,877	$1,837.56	$0.1547	516

Average cost per 100 cu. ft. contents $0.1175
Average consumption per 100 cu. ft. contents, cubic feet 392

Vapor.

No. of Building.	Contents, Cu. Ft.	Sq. Ft. of Radiation.	Cost per Season.	Season's Cost per Sq. Ft. of Radiation.	Season's Consumption per Sq. Ft. of Radiation, Cu. Ft.
9	16,200	456	$66.96	$0.1467	490
10	16,800	345	68.13	0.1974	658
	33,000	801	$135.09	$0.1687	562

Average cost per 100 cu. ft. contents $0.4094
Average consumption per 100 cu. ft. contents, cubic feet 1,365

contents in Table 1, Building Nos. 1 and 8, for steam heat supplied through gas-designed steam boilers. Vapor heating seems more consistent in the two cases reported, one showing 490 and the other 658 cu. ft.

Burners in coal-designed steam boilers in Table 2, Building Nos. 11 and 15, show 522 and 1,002 cu. ft., respectively. Burners in coal-designed vapor boilers, in the same table, report 490 and 951 cu. ft., respectively, for Building Nos. 16 and 19.

The summary in Table 3 is inconsistent because, as explained before, of large buildings being included. Eliminating these large buildings, steam and vapor heating of all classes summarizes about as follows, as shown in detail, without sub-totals, in Table 9.

No. 11. House 40 x 32 x 18 ft., extremely exposed. 70° F. maintained. 493 sq. ft. direct and 60 sq. ft. indirect radiation.

No. 12. Brick and shingle house, 43 x 69 x 20 ft., extreme exposure. 714 sq. ft. direct and 108 sq. ft. indirect radiation. 70° F. maintained.

No. 13. Frame house, 40 x 40 x 12 ft., twelve rooms. Extreme exposure. Inside temperature, 70° F. Heat regulator installed.

No. 14. Frame house, 26 x 37 x 18 ft., with 12 rooms and two baths. Exposure moderate. Temperature maintained at 72° F. Owner used bituminous coal previous winter at cost of $71. Burners installed in coal-designed steam boiler.

Fig. 15. Four-story brick building, 150 x 66 x 47 ft., two sides exposed.

Fig. 16. Ten-room frame house, 45 x 45 x 18 ft. Rather extreme exposure. 70° F. maintained. Owner used bituminous coal previous winter at cost of $80, paying $5.40 per ton.

Fig. 17. Twelve-room house, 70 x 50 x 16 ft. Exposure moderate. 72° F. maintained.

Fig. 18. Frame house, 30 x 42 x 18 ft., with eight rooms. 70° F. maintained.

Fig. 19. Eight-room frame house, 36 x 36 x 18 ft. 72° F. maintained.

Contents, Cu. Ft.	Season's Cost.	Season's Cost, 100 Cu. Ft. Contents.	Season's Consump.. 100 Cu. Ft. Contents.
116,836	$ 378.24	$0.3240	1,080
33,000	135.09	0.4094	1,365
131,096	493.29	0.3747	1,249
145,458	437.31	0.3007	1,002
426,990	$1,443.93	$0.3381	1,127

A somewhat surprising thing noted here is the low operating cost for heating homes with hot water through ordinary independent or tank water heaters. Installations of this kind are very cheap and there is a big field in house heating for this method.

Building No. 37 in Table 5 is eliminated in the grand total in Table 9. In fairness to average-sized houses it has also been eliminated in the following table which should be construed as more nearly representing a truer average than Table 5.

Contents, Cu. Ft.	Season's Cost.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consump., 100 Cu. Ft. Contents.
439,251	$ 992.67	$0.2260	753
94,214	228.18	0.2422	807
63,456	239.28	0.3371	1,257
596,921	$1,460.13	$0.2526	842

Like Building No. 5 (Table 1), reporting gas consumption on steam in a four-family house with gas-designed steam boilers, it was noted that there was a decided difference in the quantity of gas used per apartment in four suites of exactly the same size, each equipped with same kind and style of gas-designed hot water boilers, and indicating further what differences may be looked for because of different heat exactions and care, or lack of care, in operation.

A rather interesting comparison can be made of cost in dollars and cents between these two four-family houses. It happens that the same make of gas-designed steam and hot water boilers are installed in these two places.

Building No. 5 (Table 1) reports 43,200 cu. ft. of contents.

Building No. 22 (Table 4) reports 78,944 cu. ft.

Therefore, Table 4 shows 83% more cubical space than Table 1.

The season heating for steam in Building No. 5 shows a cost of $112.95; in Building No. 22, for hot water $108.99. By adding 83% to the cost in Building 5, it would show a total cost of $206.69 against $108.99 for hot water in Building 22.

Table 7 reports a minimum consumption of 583 cu. ft. of gas per 100 cu. ft. of contents through gas-designed warm air furnaces against a maximum of 1,403 cu. ft. In coal warm-air furnaces equipped with burners, it shows a minimum of 875 cu. ft. of gas and 1,954 cu. ft. as the maximum.

Summary in Table 7 shows an aver-

TABLE 2.—STEAM AND VAPOR GAS HEATING.—BURNERS AND COAL BOILERS.

No. of Building.	Contents, Cu. Ft.	Sq. Ft. of Radiation.	Cost per Season.	Season's Cost per Sq. Ft. of Radiation.	Season's Consumption per Sq. Ft. of Radiation, Cu. Ft.
			Steam.		
11	23,040	553	$86.67	$0.1566	522
12	59,340	882	186.30	0.2112	704
13	32,000	595	133.71	0.2247	749
14	17,316	312	86.61	0.2775	925
15	465,000	3,457	1,039.50	0.3006	1,002
	596,696	5,799	$1,532.79	$0.2643	881
Average cost per 100 cu. ft. contents					$0.2567
Average consumption per 100 cu. ft. contents, cubic feet					856
			Vapor.		
16	36,450	690	$101.49	$0.1470	490
17	63,000	767	149.37	0.1947	649
18	22,680	325	83.19	0.2559	853
19	23,328	362	103.26	0.2852	951
	145,458	2,144	$437.31	$0.2040	680
Average cost per 100 cu. ft. contents					$0.3007
Average consumption per 100 cu. ft. contents, cubic feet					1,002

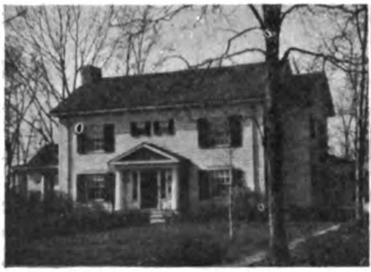


Fig. 23. Frame house, 27 x 48 x 18 ft., with ten rooms and bath. Moderately exposed. 72° F. maintained.

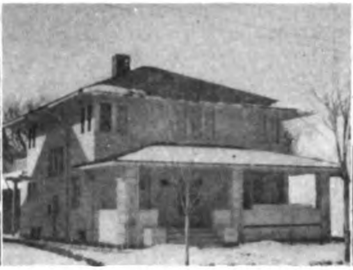


Fig. 29. Frame house, 32 x 37 x 18 ft., with nine rooms and bath. Exposure moderate. 72° F. maintained.

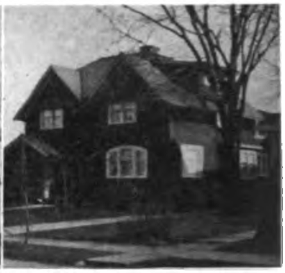


Fig. 33. Nine-room frame dwelling, 40 x 40 x 18 ft. Heated by four triple copper-coil independent or tank gas water heaters. 70° F. maintained.

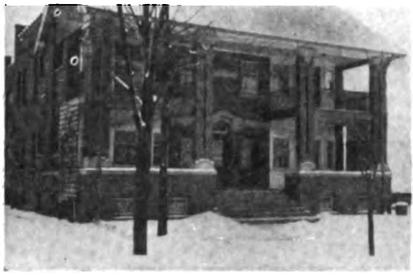


Fig. 22. Four-family apartment house. Suites 1 and 2 have each 360 sq. ft. of radiation, Numbers 3 and 4, 368 sq. ft. Six rooms in each apartment. One tenant maintains 75° F., others 70° F.

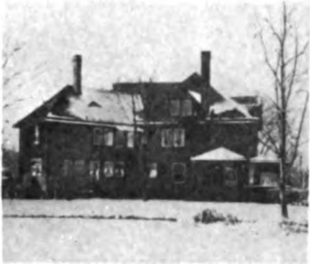


Fig. 25. Frame house, with 20 rooms and four baths. 1,124 sq. ft. of direct and 70 sq. ft. of indirect radiation. Boiler equipped with heat regulator. 72° F. maintained. Extreme exposure.

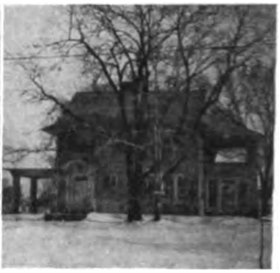


Fig. 26. Eight-room frame house, 30 x 30 x 18, extreme exposure. Heat regulator installed. 70° F. maintained.

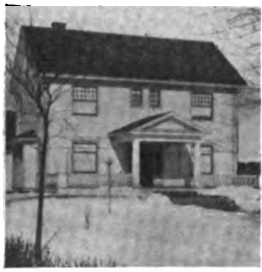


Fig. 24. Frame house, 30 x 36 x 18 ft. 70° F. maintained.

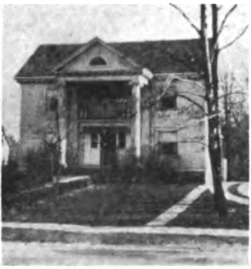


Fig. 28. Ten-room frame house, 40 x 40 x 18 ft. Heat regulator attached. 70° F. maintained.

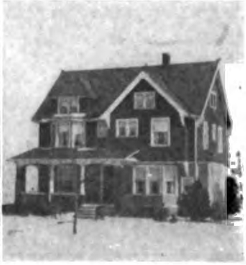


Fig. 30. Frame house, 38 x 25 x 18 ft., nine rooms and bath. 70° F. maintained.

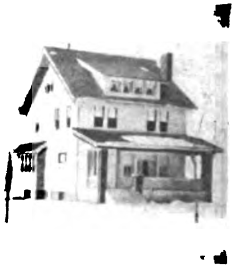


Fig. 31. Frame house, 23 x 29 x 18, with six rooms and bath. 72° F. maintained.

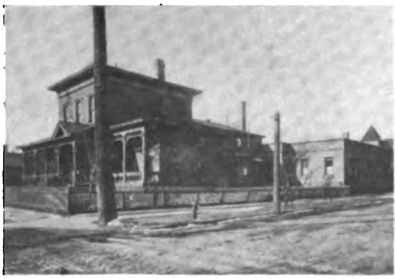


Fig. 21. Children's day nursery, 22 x 75 x 20 ft. Moderate exposure. 70° F. maintained.

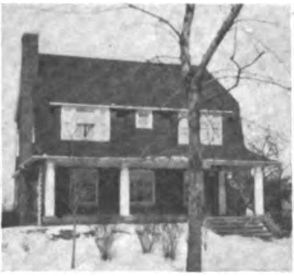


Fig. 27. Frame house, 32 x 34 x 18 ft., with ten rooms. Heat regulator attached. 70° F. maintained.

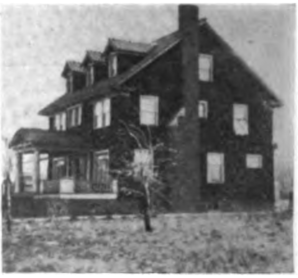


Fig. 34. Frame residence, 36 x 36 x 20 ft., with twelve rooms and bath.

age consumption for each 100 cu. ft of contents for warm air heating in gas designed furnaces of 849 cu. ft. of gas against 1,148 cu. ft. for burners in coal warm air furnaces.

Table 8, general summary, reports gas used as actually shown by metered consumption detailed in Tables 1 to 6, inclusive, regardless of whether or not the figures were consistent. To show how

Fig. 20. House with eight rooms and bath, 33 x 51 x 18 ft. Extreme exposure. 72° F. maintained by heat regulator attached to gas-designed hot water boiler.

Fig. 35. Frame residence, 51 x 43 x 18 ft., with eleven rooms and two baths. Heat regulator installed on gas line to water heaters. 68° F. maintained. Exposure moderate.

Fig. 32. Ten-room frame residence, 24 x 40 x 18 ft., extremely exposed. 72° F. maintained.

TABLE 3.—STEAM AND VAPOR GAS HEATING.—SUMMARY OF AVERAGE COSTS OF ALL CLASSES UNDER THIS HEADING.

Contents, Cu. Ft.	Season's Cost.	Season's Cost Contents. per 100 Cu. Ft.	Season's Consumption per 100 Cu. Ft. Contents, Cu. Ft.
1,563,412	$1,837.56	$0.1175	392
33,000	135.09	0.4094	1,365
596,696	1,532.79	0.2567	856
145,458	437.31	0.3007	1,002
2,338,566	$3,942.75	$0.1686	562

TABLE 4.—HOT WATER HEATING.—GAS DESIGNED BOILERS.

Hot Water.

No. of Building.	Contents, Cu. Ft.	Sq. Ft. of Radiation.	Cost per Season.	Season's Cost per Sq. Ft. of Radiation.	Season's Consumption per Sq. Ft. of Radiation, Cu. Ft.
20	30,294	900	$61.50	$0.0684	228
21	61,660	1,397	100.62	0.0720	240
22	78,944	1,456	108.99	0.0749	249
23	23,328	823	63.27	0.0768	256
24	19,440	618	50.07	0.0810	270
25	92,016	1,194	115.44	0.0966	322
26	16,200	499	51.06	0.1023	341
27	19,584	616	64.83	0.1053	351
28	28,800	657	93.33	0.1422	474
29	21,312	505	73.14	0.1448	483
30	18,387	445	66.21	0.1488	496
31	12,006	341	55.59	0.1632	544
32	17,280	431	88.62	0.2055	685
	439,251	9,882	$992.67	$0.1004	335
Average cost per 100 cu. ft. contents					$0.2260
Average consumption per 100 cu. ft. contents, cubic feet					753
GAS DESIGNED TANK WATER HEATERS.					
33	28,800	659	$61.38	$0,0931	310
34	25,920	721	72.60	0.1008	336
35	39,494	739	94.20	0.1275	425
	94,214	2,119	$228.18	$0.1077	359
Average cost per 100 cu. ft. contents					$0.2422
Average consumption per 100 cu. ft. contents, cubic feet					807

inconsistent they prove, note the total for gas consumed per 100 cu. ft. of contents for houses and buildings of all kinds, 634 cu. ft. of gas (Table 8) against 950 cu. ft. (Table 9), with large buildings eliminated and inconsistent figures omitted.

Table 9, with large buildings and inconsistent figures not included, summarizes as follows, for gas consumed per 100 cu. ft. of contents:

	Cubic Feet.
Hot water heating	842
Warm air heating	981
Steam and vapor heating	1,127
Average	950

If our groups of installation may be construed as proper and to represent a true average, generally speaking, hot water heating is cheapest, warm air next, costing 14.2% more than hot water, and steam highest, costing 25.30% more than hot water and 13% more than warm air.

One of the manufacturers of gas-designed steam and hot water boilers recently had a table of costs showing month by month from winter of 1909-1910 to 1914-1915, inclusive, cost for gas consumed in a gas-designed water boiler. Table is noted below to show how consistent this owner's costs have been for six winters. This boiler was used in a two-story brick and shingle building with tile roof. The outside dimensions were 30 x 42 x 18 ft. Eleven radiators were installed which combined a radiation of 700 sq. ft.

The average day and night temperature maintained was 74½° F. Water temperature at zero, 170° F.

To secure these figures a deduction was made from total bill of $1.20 per month for cooking, laundry and water heating.

	1909 1910	1910 1911	1911 1912	1912 1913	1913 1914	1914 1915
November	$ 5.00	$ 7.50	$ 7.80	$ 6.00	$ 9.00	$ 5.70
December	8.00	12.30	12.00	10.50	8.40	12.60
January	11.90	12.40	13.50	13.80	14.70	14.40
February	9.90	12.60	21.00	14.10	14.10	14.40
March	12.00	9.00	13.20	17.10	15.90	11.10
April	5.10	13.50	8.10	4.80	8.40	9.60
	$51.90	$69.30	$75.60	$66.30	$70.50	$67.80
Average per sq. ft. rad.	6.4c	8.8c	9.8c	8.4c	9.0c	8.6c
Av. outside temperature, deg. F.	36°	34°	31°	37°	35°	....

Fig. 36. Twelve-room frame house, 54 x 28 x 18 ft. Exposure moderate. 70° F. maintained.
Fig. 37. House, 50 x 140 x 27 ft., with 40 rooms. 70° F. maintained.

Fig. 38. Eight-room frame house, 33 x 31 x 18 ft. Gas burners in coal-designed hot water boiler. Extreme exposure. 70° F. maintained.

Fig. 39. Brick and frame house, 32 x 33 x 18, with eleven rooms and bath. Gas burners installed in coal-designed boiler. Temperature maintained at 78° F. Exposure moderate.

DESCRIPTION OF INSTALLATIONS TESTED.

The illustrations following picture four kinds of gas-designed hot water boilers. No photographs are shown of any of the same makes of gas-designed steam boilers, for there is little difference in the outside appearance. Boilers used for steam are larger, so that part of the space at the top is used as a steam dome. Fig. 1 shows the gas-designed hot water boiler installed as an auxiliary beside the coal boiler in Building No. 20.

The copper coil gas-designed hot water boiler shown in Fig. 2 heats Building No. 23. This boiler is connected as auxiliary to the coal boiler.

The huge gas-designed hot water boiler shown in Fig. 3 heats Building No. 25. It is of cast-iron sections and is connected as an auxiliary to the coal boiler.

The cast-iron sectional gas-designed hot water boiler shown in Fig. 4 heats Building No. 28. This boiler is connected as auxiliary to the coal boiler.

A photograph is shown in Fig. 5 of four tank or independent gas water-heaters which heat Building No. 34. These are what are known as triple copper-coil water heaters. Each heater contains 27 ft. of coil. They are connected as can be seen, as an auxiliary system to the coal boiler. A heat regulator controls the gas supply to the heaters.

The eight double copper copper-coil tank water-heaters, connected as auxiliary to coal boiler cannot be seen in Fig. 6, because the owner of this home (No. 35) has encased them in a sheet iron jacket to prevent heat loss through radiation. Jacket can be seen to left at rear of boiler. Each heater contains 22 ft. of copper coil. The gas supplied to these heaters is controlled with a heat regulator. Note comparison in size between gas and coal installation. Coal boiler would not heat home properly.

Fig. 7 shows the coal-designed hot water boiler equipped with gas burners installed in Building No. 38.

Another style of coal-designed hot water boiler fitted with gas burners is shown in Fig. 8. It heats Building No. 39. It is hardly necessary for me to say this is not the most desirable location for a meter.

There are many ways of installing burners in coal-designed steam and hot water boilers. We are not so egotistical as to think or say our's is the best possible way of making burner installations. It is the best way we have found to date, and we can recommend it as satisfactory for most installations.

Fig. 9 shows a front view as it appears with burners installed in a steam or hot water coal-designed boiler. First the grates are removed and a piece of sheet iron is fitted at the bottom of the boiler

TABLE 5.—HOT WATER HEATING.—BURNERS IN COAL BOILERS.

Hot Water.

No. of Building.	Contents, Cu. Ft.	Sq. Ft. of Radiation.	Cost per Season.	Season's Cost per Sq. Ft. of Radiation.	Season's Consumption per Sq. Ft. of Radiation, Cu. Ft.
36	27,216	749	$68.04	$0.0909	303
37	189,000	2,830	399.78	0.1413	471
38	17,232	671	96.03	0.1431	477
39	19,008	316	75.21	0.2379	793
	252,456	4,566	$639.06	$0.1399	466

Average cost per 100 cu. ft. contents.. $0.2531
Average consumption per 100 cu. ft. contents, cubic feet.......................844

TABLE 6.—HOT WATER HEATING.—SUMMARY OF AVERAGE COSTS OF ALL CLASSES UNDER THIS HEADING.

Contents, Cu. Ft.	Season's Cost.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consumption per 100 Cu. Ft. Contents, Cu. Ft.
439,251	$992.67	$0.2260	753
94,214	228.18	0.2422	807
252,456	639.06	0.2531	844
785,921	$1,859.91	$0.2367	789

Fig. 41. House, 40 x 30 x 18 ft., with eight rooms and bath. No coal furnace in this house. 70° F. maintained during daytime, 60° F. during nighttime. Heat regulator attached to gas line supplying furnace. Fresh air taken from outside.

Fig. 42. Seven-room dwelling, 32 x 26 x 18 ft., warm air furnace connected as auxiliary to coal furnace. Extremely exposed. 65° F. maintained. Air taken from basement. Owner reports coal cost previous winter of $52.

Fig. 45. Eight-room frame residence, 60 x 36 x 18 ft., with gas burners in a coal-designed warm air furnace, with heat regulator attached. 75° F. maintained. Air taken from both inside and outside.

Fig. 46. Eight-room frame house, 16 x 48 x 16 ft., with gas burners installed in coal-designed warm air furnace. Half of double house and has three sides exposed. 70° F. maintained. Air taken from basement.

Fig. 40. Frame house, 36 x 51 x 18 ft., with eight rooms and bath. 75° F. maintained. Air taken from basement. Owner reports using anthracite coal previous winter at a cost of $83.

Fig. 43. House, 36 x 36 x 18 ft., with twelve rooms and bath. Extreme exposure. Gas-designed warm air furnace connected as auxiliary to coal furnace. 72° F. maintained.

Fig. 44. Frame dwelling, 19 x 27 x 18 ft. Gas burners installed in coal warm-air furnace. 70° F. maintained. Air taken from basement. Owner reports coal cost previous winter of $52.

Fig. 47. Frame house, 23 x 27 x 18 ft., six rooms and bath. 72° F. maintained. Air taken from basement. Consumer reports coal cost of $50 the previous winter.

TABLE 7.—WARM AIR GAS HEATING.—GAS DESIGNED FURNACES.

Warm Air.

No. of Building.	Contents, Cu. Ft.	Season's Cost.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consumption per 100 Cu. Ft. Contents, Cu. Ft.
40	33,048	$57.75	$0.1749	583
41	21,600	41.31	0.1914	638
42	14,976	39.21	0.2619	873
43	23,328	98.28	0.4209	1,403
	92,952	$236.55	$0.2546	849
BURNERS IN COAL FURNACES.				
44	38,880	$102.06	$0.2625	875
45	13,924	44.64	0.3207	1,069
46	11,178	51.30	0.4590	1,530
47	9,234	54.12	0.5861	1,954
	73,216	$252.12	$0.3443	1,148

SUMMARY.

Contents, Cu. Ft.	Season's Cost.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consumption per 100 Cu. Ft. Contents, Cu. Ft.
92,952	$236.55	$0.2546	849
73,216	252.12	0.3443	1,148
166,168	$488.67	$0.2942	981

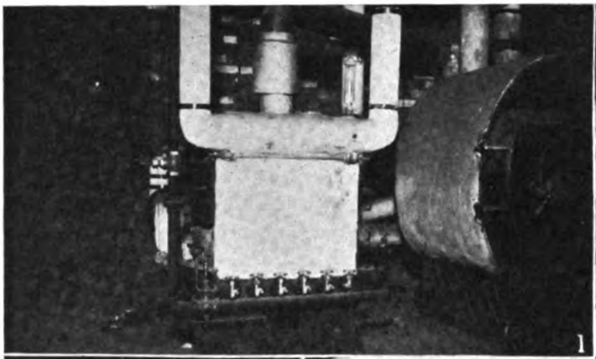
TABLE 8.—GENERAL SUMMARY.

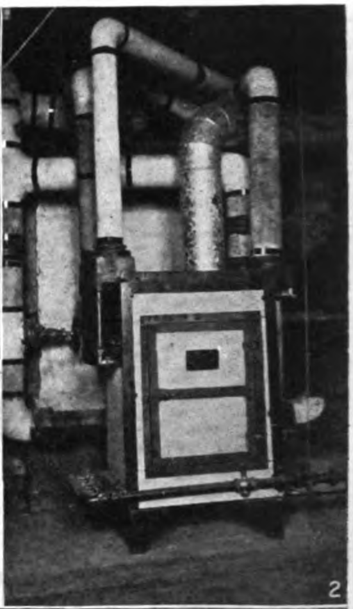
	Contents, Cu. Ft.	Sq. Ft. Rad.	Season's Cost.	Season's Cost per Sq. Ft. Rad.	Season's Consumption per Sq. Ft. Rad., Cu. Ft.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consumption per Cu. Ft. Contents, Cu. Ft.
Gas designed boilers, steam	1,563,412	11,877	$1,837.56	$0.1547	516	$0.1175	392
Gas designed boilers, vapor	33,000	801	135.09	0.1687	562	0.4094	1,365
Coal designed boilers, steam	596,696	5,799	1,542.79	0.2645	882	0.2567	856
Coal designed boilers, vapor	145,548	2,144	437.31	0.2039	680	0.3007	1,002
Gas designed boilers, water	439,251	9,882	992.67	0.1004	335	0.2260	753
Coal designed tank heaters, water	94,214	2,119	228.18	0.1077	359	0.2422	807
Coal designed boilers, water	252,456	4,566	639.06	0.1399	466	0.2531	844
Gas designed furnaces, air	92,952	....	236.55	....	....	0.2546	849
Coal designed furnaces, air	73,216	....	252.12	....	....	0.3443	1,148
		GRAND	TOTALS.				
Steam and vapor gas heating	2,338,566	....	$3,942.75	....	....	$0.1686	562
Hot water gas heating	785,921	....	1,859.91	....	....	0.2367	789
Warm air gas heating	166,168	....	488.67	....	....	0.2942	981
Average cost of heating, all kinds	......	....	......	....	....	0.1902	634

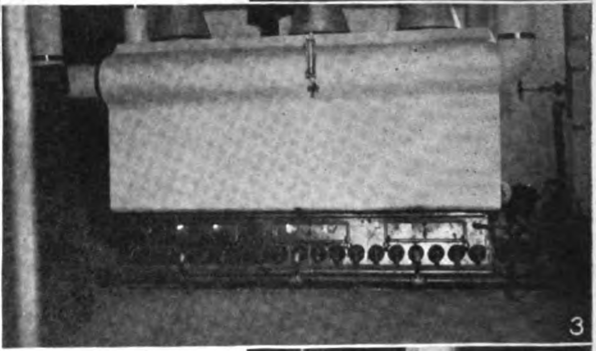
TABLE 9.—ELIMINATING LARGE BUILDINGS.—HOME GAS HOUSE-HEATING ONLY.

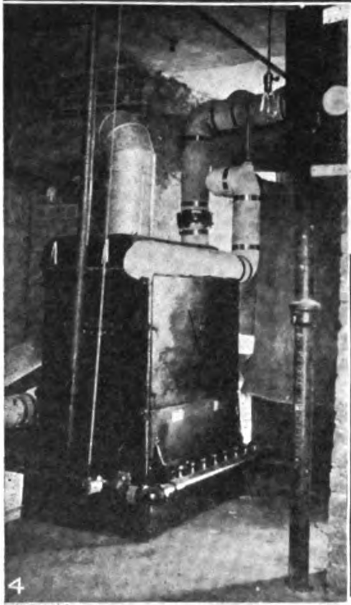
	Contents, Cu. Ft.	Sq. Ft. Rad.	Season's Cost.	Season's Cost per Sq. Ft. Rad.	Season's Consumption per Sq. Ft. Rad., Cu. Ft.	Season's Cost per 100 Cu. Ft. Contents.	Season's Consumption per 100 Cu. Ft. Contents, Cu. Ft.
Gas designed boilers, steam	116,836	2,275	$378.24	$0.1667	554	$0.3240	1,080
Gas designed boilers, vapor	33,000	801	135.09	0.1687	562	0.4094	1,365
Coal designed boilers, steam	131,696	2,342	493.29	0.2104	702	0.3747	1,249
Coal designed boilers, vapor	143,458	2,144	437.31	0.2040	680	0.3007	1,002
Gas designed boilers, water	439,251	9,882	992.67	0.1004	335	0.2260	753
Gas designed boilers, tank heaters	94,214	2,119	228.18	0.1077	359	0.2422	807
Coal designed boilers, water	63,456	1,736	239.28	0.1377	459	0.3771	1,257
Gas designed furnaces, air	92,952	....	236.55	....	....	0.2546	849
Coal designed furnaces, air	73,216	....	252.12	....	....	0.3443	1,148
		GRAND	TOTALS.				
Steam and vapor gas heating	426,990	7,562	1,443.93	$0.1909	636	$0.3381	1,127
Hot water gas heating	596,921	13,737	1,460.13	0.1062	354	0.2526	842
Warm air gas heating	166,168	....	488.67	....	....	0.2942	981
Average cost of house-heating, all kinds	......	....	......	....	....	0.2851	950

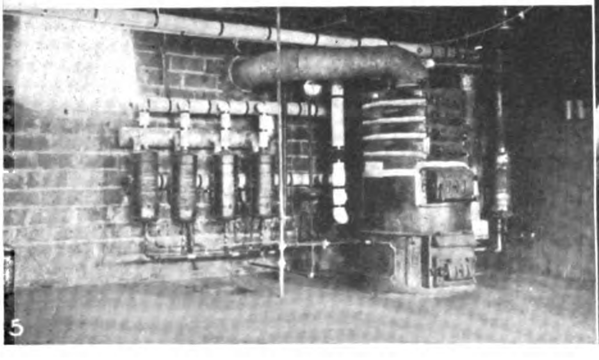
Note.—This table does not include figures shown in Summary (Table 8) or Tables 1, 2, 3, 4, 5, 6 and 7 and Buildings Nos. 1, 4, 6, 7, 15, 37 and 44.

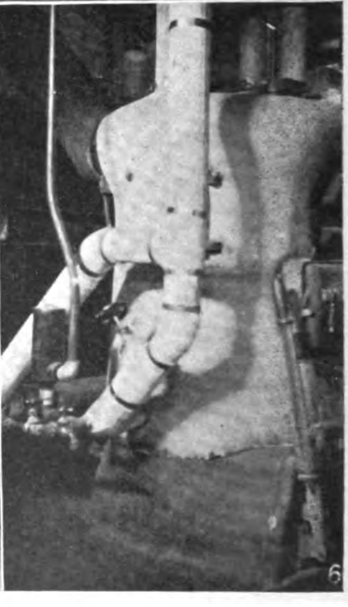












TYPES OF GAS HEATERS INSTALLED IN THE BUILDINGS TESTED.

on the grate rests. This is purposely made not to fit too snugly at the sides, front and back and holes are cut a trifle too large for burner supply pipes to allow enough secondary air to pass through to support combustion.

Mixers, as will be observed, are in the ash-pit below sheet-iron plate. Side burners are installed from front to back above sheet-iron bottom parallel to side walls. In the center, round heater burners are installed. Between center and side burners are placed rows of fire brick. Over the side burners are checked fire brick which deflect the heat against the water legs.

Above this, broken fire brick is thrown in, which tends to maintain a high flame temperature and at the same time hold back the products of combustion. The side burners only are used except when temperature is at zero or below, when it may be necessary to use center burners for quick heat.

Fig. 10 shows view of burner installation in steam or hot water boiler looking down from the top.

Fig. 11 shows a gas-designed warm air furnace installed as an independent or direct furnace, and heats Building No. 41. It is controlled by a heat regulator. Pilot can be seen lighted through open door. As in Fig. 8, sub-meter is badly located.

A view of the rear of both the coal and gas furnaces showing method of connecting gas-designed furnace as auxiliary to coal warm air furnace is shown in Fig. 12.

In this installation, which heats Building No. 42 fresh air supply may be taken through fresh air duct leading to coal furnace from outside or from cellar floor.

Fig. 13 shows a large size gas-designed warm air furnace connected as auxiliary to coal furnace for heating Building No. 43. One direct heating lead is taken from top of gas furnace, balance of leads are connected from coal furnace.

A coal-designed warm air furnace fitted with gas burners is shown in Fig. 14. This furnace heats Building No. 47.

Like burner installation illustrated and described for steam and hot water boilers, the burner installation shown in Fig. 15 is the best we have found to date for use in coal designed warm air furnaces.

Burners like these are used in round steam and hot water coal boilers as well as warm-air coal furnaces. The efficiency is not as great as we should like to have it, but for a cheap serviceable installation it answers every practical purpose. After removing grates from coal furnace a sheet-iron plate is cut to not too snugly fit in fire pot on grate rests, and holes are cut to allow burner supply pipes to pass through, somewhat larger than needed to provide enough secondary air to support combustion. A sunflower type of sectional burner of two, three or four sections is used whose diameter is somewhat smaller than the fire pot, at point where burner is installed. Whole fire brick are then laid on the top of the burner in the center and checked brick around the edge of the fire pot, one resting on burner, the other against fire pot to deflect heat against fire pot. Later broken fire brick is thrown in to help maintain a high flame temperature and to hold back the products of combustion. Enough broken fire brick may be used to bring top level up to 3 or 4 in. of bottom of fire door.

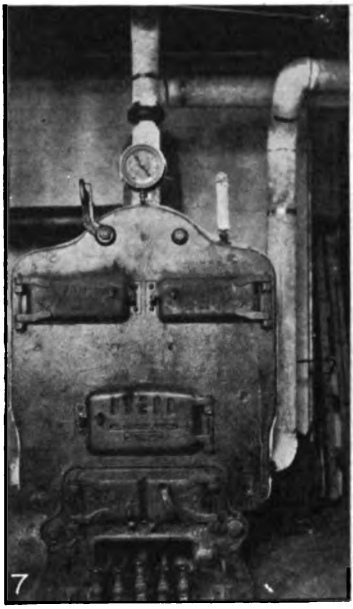
ECONOMY OF GAS DESIGNED HEATERS.

Gas-designed boilers and furnaces are unquestionably cheaper to operate than any burner that possibly could be installed in coal boilers or furnaces.

As much economy in gas consumption should be practiced as possible in making burner installations, even in those sections where coal is sold at a high price, for the time will come when natural gas will not be so plentiful as it is today and we will have need then, if not now, to meet competition in other fuels, because of probable advances in cost of gas.

Experiments are constantly being made in the effort to learn better ways for applying gas to coal-designed house heating appliances. We have learned of some refinements in our present installations to increase efficiency and are about to try them out in actual practice following our laboratory tests, but are not prepared to advocate them until we ascertain how practical they may prove.

Manufacturers of gas-designed house



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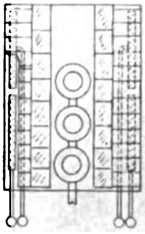
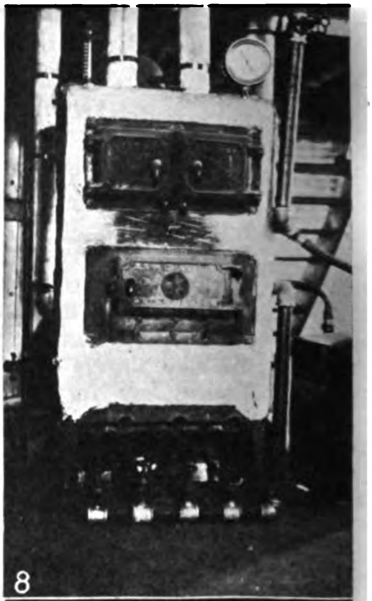


Burner Installation
in
Coal Boiler

10



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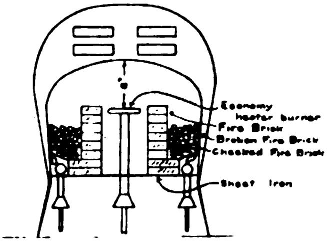

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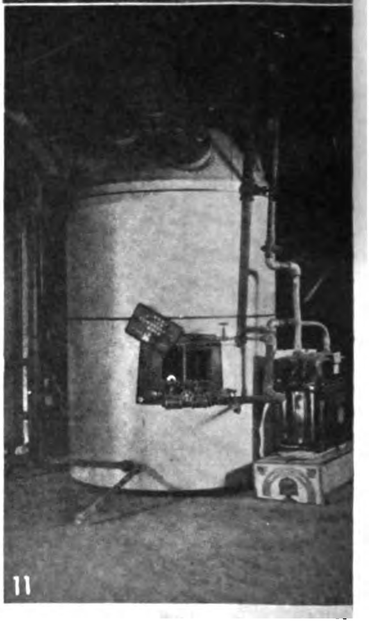

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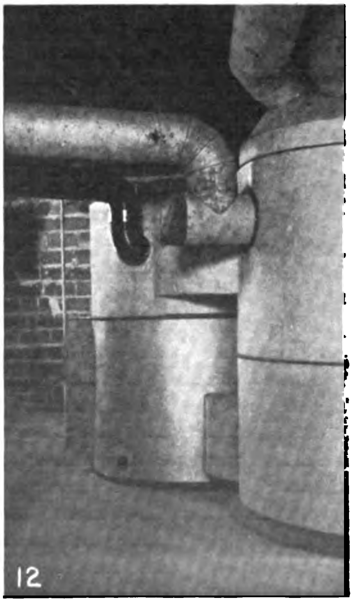

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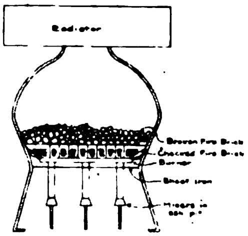

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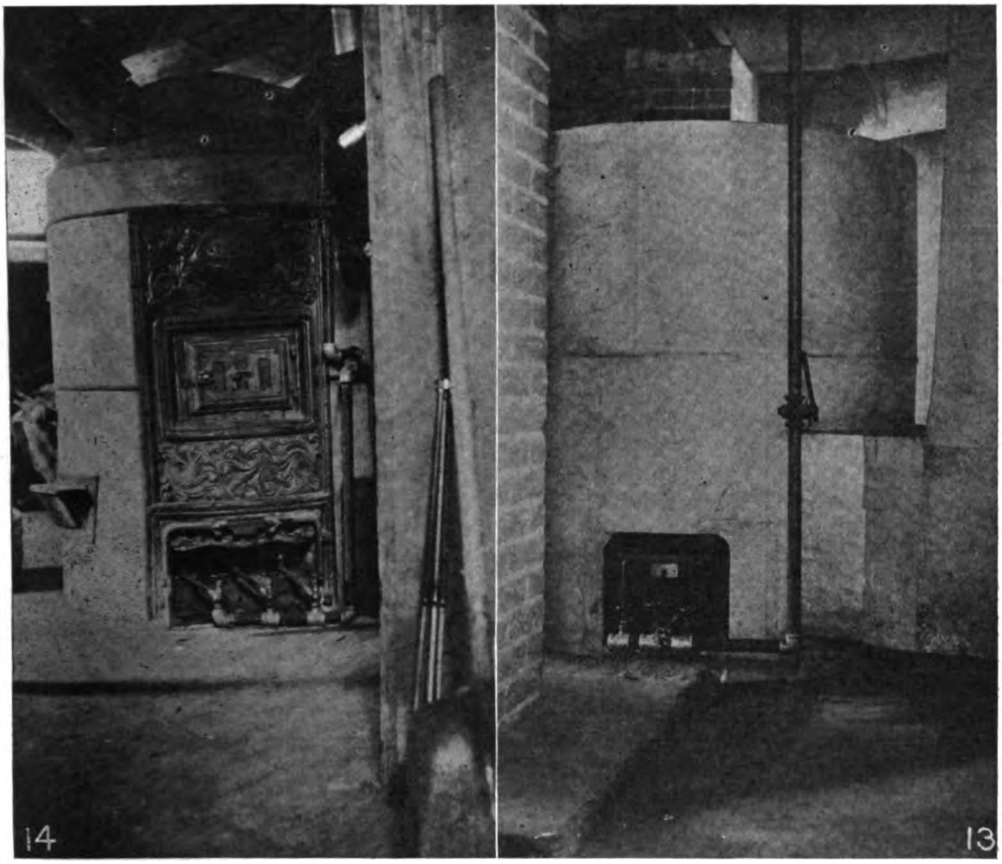
Burner Installation
in
Hot Air Furnace

TYPES OF GAS HEATERS INSTALLED IN THE BUILDINGS TESTED.



TYPES OF GAS HEATERS INSTALLED IN THE BUILDINGS TESTED.

heating boilers and furnaces are also hard at work, constantly endeavoirng to improve the efficiency of their product and the future will doubtless see wonderful strides in this direction.

Discussion.

In the discussion of the paper it was brought out that as much care is required in the manipulation of the check draft on the flue pipe leading from the coal furnace as is required in any other portion of the apparatus. A safety damper is favored, having a hole in the center. This is kept closed as much as possible without smothering the flames in the furnace. Some of the heat must be allowed to escape to carry away the products of combustion, otherwise there would be moisture in the flue pipe or chimney which sometimes causes trouble by seeping through the brick in the chimney and ruining the decorations in the home.

In reply to a question as to why the mixers are placed directly under the grates rather than in front of the fire pot door, it was stated that there is some heat radiation in the iron plate at the bottom of the furnace and it preheats the air somewhat to have the air mixers in the ash pit.

Combination coal and gas furnaces, it appeared from the discussion, are not very satisfactory for gas. The burners installed in them are wasteful of gas for the reason that the heat is not applied at the proper point.

One speaker asked if some of the low operating cost figures obtained might not be due to the prolonged absence of a family. He was informed that no watch was kept over the houses in this connection. It was admitted that some of the costs were very low.

New Apparatus for Testing Heat Losses

In connection with an elaborate project for revising practically all of the existing so-called standard coefficients for calculating heat transmission through building materials, radiators, etc., some of the recent work done in this direction at the University College in London is described by A. H. Barker, B. Sc., in *Domestic Engineering* (London).

It will be recalled that some time ago the (British) Institution of Heating and Ventilating Engineers formed a committee for the express purpose of carrying out this work and the committee has requested the heating and ventilating department of the University College to take the lead in the experimental part of the work.

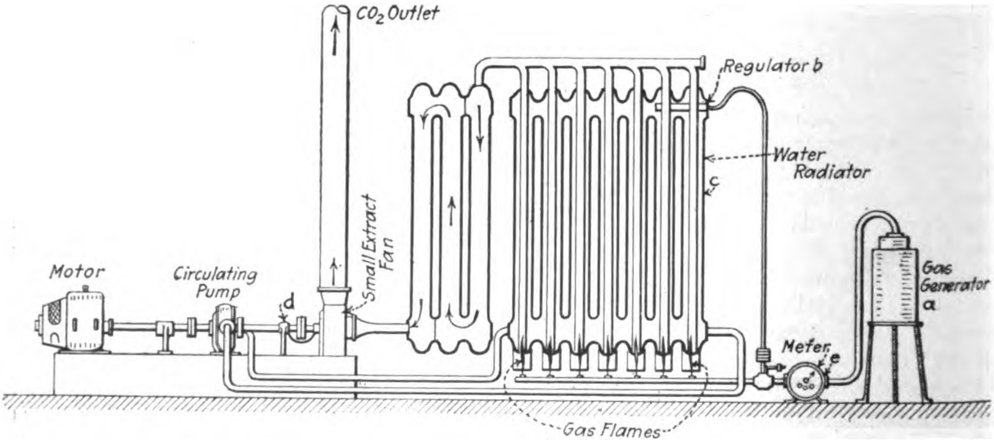
In answer to the question, "What do we require for practical purposes?" Mr. Barker expresses the opinion that we require to find the absolute values and not merely the proportional magnitudes of a set of coefficients, such that if they are adopted in connection with a correct and scientific method of calculation from the area of walls, roof, windows, etc., the result secured will be one which a customer will generally find satisfactory; which will, in other words, with a freezing temperature outside, maintain a suitable feeling of warmth which may be taken to correspond to an approximate temperature of 60° or 65° F. indoors, with heating interrupted during the night. We desire further to know as nearly as possible the practical effect on the transmission and on the temperature of variations in the interruption of heating, outdoor conditions, such as wind, rain, sunshine, etc.

PORTABLE APPARATUS REQUIRED.

One of the first requisities determined by previous experiments, is a portable apparatus consisting of radiators and means for heating them, which can be installed in a room without much difficulty. The essential features of such an apparatus are that it can be heated to any desired degree, that the exact amount of heat given off from it can be measured, and finally, that it must be self-contained and light.

APPARATUS FOR MEASURING HEAT LOSSES FROM ROOMS.

Such an apparatus, designed by Mr. Barker for determining the heat losses from rooms, is shown in Fig. 1. a is an acetylene generator capable of generating a considerable volume of acetylene or other gas, as may be necessary to supply heat to the radiator; b is a regulator surrounded on all sides by water for maintaining at a constant value the temperature of the water in the radiator. The regulator may also be arranged to be operated by the temperature in the room.



APPARATUS DESIGNED BY A. H. BARKER FOR MEASURING HEAT LOSSES FROM ROOMS.

c is a radiator of special make containing tubes so arranged that the water can be heated in it by the combustion of gas generated in the apparatus a. d is a small air pump for abstracting the waste gases. There is an additionl pump for maintaining a constant circulation of water in the radiator, the pipes on the heater being made long enough to absorb practically the whole of the heat from the waste gases almost down to the temperature of the water. Several of the radiator coils might be used as shown for further abstracting the heat from the gases. e is a self-registering gas meter.

HOW THE APPARATUS OPERATES.

The method of observation is as follows:

First measure the acetylene gas used and make a careful determination of the calorific value of the same. Then light the burners and set the motors at work. The vitiated gases are drawn off through the coil in which most of the heat of combustion of the gas is abstracted and then discharged into the room at several different points.

In this way the radiator may be maintained at any required temperature which is automatically regulated to suit the desired temperature conditions in the room. Careful and continuous observation has to be made by means of continuously recording thermometers of the inside and outside temperatures, wind, etc., and continuous observation also made of the interchange of air. The latter may be accomplished through a carbonic acid test.

In testing rooms having fixed heating apparatus, it is proposed to produce the CO_2 by the combustion of weighed quantities of sperm candles. If the method above outlined is used for rooms having no existing heating apparatus, the quantity of CO_2 can be measured by the same means used in producing the heat.

The gas, acetylene, which is used, is of known composition and known calorific value, and the quantity of CO_2 produced by the combustion of a known volume of it can be calculated easily. Therefore, to obtain the interchanges it is only necessary to analyze the air continuously and make calculations on the result.

LENGTHY TESTS NECESSARY.

These experiments would have to be conducted until the room attained a constant temperature which would have to be maintained thereafter. The hourly consumption of heat in maintaining this temperature would have to be calculated from the consumption of gas and careful calculations made of the dimensions of the room, the temperature on each side of every wall and all other matters having a bearing on the loss of heat from the room.

The actual amount of heat loss would then be compared with the calculated amount, based on the given inside and outside temperatures. If the present coefficients are found to be in error, then the laboratory experiments here indicated will furnish the relative proportion of the respective coefficients. If this process were carried out for a large number of rooms, a very reliable set of figures could be obtained.

In Mr. Barker's opinion, each room should be experimented on during cold weather for at least one week and it is estimated that this would require the entire time of two men. It is proposed to obtain permissions from owners of unused houses, preferably furnished, for the experiments.

DESIGN OF APPARATUS FOR MEASURING RADIATOR HEAT TRANSMISSION.

The experiments should not, of course, be confined to dwelling houses, but the size of testing apparatus necessary to conduct a similar test on a large hall, for instance, would be considerable. For this reason large buildings would have to be tested with radiators already provided. It might be sufficient to make tests of a plant by taking frequent readings of the surface temperatures of each of the radiators and calculating the heat given off from each. In order to do this it will be necessary to develop considerably the methods which we have at present for determining the actual value of the surface temperature of radiator or pipes.

Mr. Barker then described what had already been accomplished in this direction by his staff, using the principle of resistance thermometers. The method is to attach a known resistance to the surface of a flexible non-conducting envelope, such that it can be pressed into contact with the surface, the assumption being that the coil will take up the temperature of the surface. Special methods of calibration, of course, would be required.

Humidity and Its Measurement

By Kenneth G. Smith.*

According to the law of partial pressures, commonly known as Dalton's Law, two gases at the same temperature do not interfere with each other's pressures when mixed, provided there is no chemical action. Each one exerts the same pressure that it would at the given temperature if the other were not present. The total pressure is the sum of the pressures of the two gases. Experiment shows that this law holds good for a mixture of gas and vapor, such as water vapor and air. Taking water vapor and air as an example, if Pa is the air pressure and Po the vapor pressure, then $Pa + Po = Pt$ = total pressure of vapor and air.

If the vapor is saturated, the temperature of the mixture is definitely fixed at the saturation temperature corresponding to the pressure Pt. If the temperature is higher than the saturation temperature at the given pressure, the vapor is superheated. Water vapor in the atmosphere is superheated except on damp, foggy days when the water vapor is saturated or, as we say, the air is saturated with moisture.

The weight of 1 cu. ft. of superheated vapor is less than the weight of 1 cu. ft. of saturated vapor. If m_1 is the weight of a cubic foot of saturated vapor and m_2 = weight of a cubic foot of superheated vapor at the same temperature, then the ratio $\frac{m_2}{m_1}$ expressed in per cent. is the relative humidity of the air containing the vapor. That is, it is the ratio of the moisture actually contained in the air to that which the air could contain at that temperature if saturated.

If a mixture of air and superheated vapor is cooled at constant pressure (say atmospheric pressure), it will finally reach a point where the vapor becomes saturated instead of superheated and further results in condensation. The temperature at which condensation begins, that is the dew point is simply the saturation temperature for the given pressure. The gas law PV = constant, which we may assume holds good for low vapor pressures, gives us the means of calculating the ratio $\frac{m_2}{m_1}$ referred to above as the relative humidity.

Let P_1 V_1 represent the condition of saturated vapor at the given temperature and P_2 V_2 its actual condition at this temperature, that is, in its superheated state.

$$P_2 V_2 = P_1 V_1 \text{ and } \frac{P_2}{P_1} = \frac{V_1}{V_2}$$

Consider now that the vapor is cooled at a constant pressure P_2 down to the saturation temperature, that is, to the dew point. Since P_2 is unchanged the ratio $\frac{P_2}{P_1} = \frac{V_1}{V_2}$ still holds good. If now we substitute for the volumes per cubic foot, their reciprocals, the weight per cubic foot, we have $\frac{P_2}{P_1} = \frac{m_2}{m_1}$

Hence, the relative humidity in per cent. is equal to the ratio of the pressure (corresponding to the dew point) to the saturation pressure (corresponding to the temperature of the mixture).

A TYPICAL EXAMPLE.

An example will make this method of measuring humidity clear. Suppose that air has a temperature of 70°F. and the dew point is found to be 55°F. What is the humidity and weight of vapor per cubic foot? From a table of vapor pressure we find that at 55° the saturation pressure is 0.436 in. of mercury. At 75° the saturation pressure is 0.8735 in. of mercury. The relative humidity is then

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*Director Engineering Extension, Iowa State College, Ames, Iowa.

$\frac{0.436}{0.8735}$ = 50 per cent., very nearly. If the air were saturated at 75° it would contain 9.36 grains of moisture per cubic foot. Hence, at 50 per cent. saturation it contains $9.36 \times 0.5 = 4.68$ grains per cubic foot.

To measure moisture in this way would be difficult under other than laboratory conditions and for that reason the method using a wet and dry bulb thermometer is more generally used. The dry bulb thermometer is simply an ordinary Fahrenheit thermometer. The wet bulb thermometer is exactly the same except that it has a piece of muslin or other porous material wrapped around the bulb and saturated with water. When both are exposed to the air, the wet bulb thermometer immediately falls to a lower temperature than the dry bulb thermometer, due to the fact that the evaporation of the moisture in the cloth requires heat. The drier the air, the more the evaporation and the greater the drop in temperature. From the difference in temperature between the wet and dry bulb thermometers the humidity may be calculated. In practice it is not calculated but read directly from a table or curve.

EXPLANATION OF WET BULB TEMPERATURES.

One might naturally ask the reason for the fixed temperature to which the wet bulb thermometer drops. This temperature is known as the temperature of adiabatic saturation and is fixed for any dry bulb temperature and percentage of humidity. To understand this statement imagine three thermometers placed in a body of air to which moisture is to be added without exchange of heat with any source outside of the air and water. The first thermometer is arranged to show the dew point and reads the lowest. The second or dry bulb thermometer shows the dry bulb temperature or as we call it, the temperature of the air. The third thermometer shows a temperature between the dry bulb temperature and the dew point. To make the case concrete let us consider air at 70° and 33 per cent. saturated. Conditions are then as follows:

Dry bulb temperature........	70°
Dew point..................	39°
Wet bulb temperature........	54°

If now a fine spray of water having a temperature higher than 39° is introduced, the air absorbs moisture with the result that the dry bulb temperature drops at once, the dew point temperature rises and the wet bulb temperature remains stationary. The reason is that the total heat of the air is constant. The heat required to evaporate the moisture is rendered latent and the sensible heat as shown by the dry bulb thermometer becomes less, but the sum of latent and sensible heat is constant. If moisture continues to be added the dew point temperature continues to rise, the dry bulb temperature continues to fall until all three are stationary at the wet bulb temperature, when the air is saturated. The total heat of the air is the same as it was before the moisture was added, but it contains more latent and less sensible heat. On the total heat the wet bulb temperature depends, and, therefore, it is fixed for any temperature and percentage of humidity, because the total heat of the air in the given condition is fixed.

In the above example the percentage of humidity may be calculated if we know the dry and wet bulb temperatures. These are as given, dry bulb 70°, wet bulb 54°, 54° is the temperature of adiabatic saturation and at this temeprature the air contains 62.14 grains per pound when saturated. The total heat of the mixture equals the heat of the air plus the heat of the moisture $= 0.2375 \times 54 + \frac{1084.7 \times 62.14}{7000} = 22.44$ B. T. U. Since the total heat of the air is constant during the change the total heat at 70° equals the total heat at 54°.

$0.2375 \times 70 + (1084.7) + (48 \times 16) \times X = 22.44.$

X = grains of moisture in air at 70°.

0.48 = specific heat of the vapor.

Solving for X we have X = 37.2 grains per pound of air.

Since saturated air at 70° contains 110.01 grains per pound the humidity is $\frac{37.2}{110.01}$ = 33 per cent.

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A REMARKABLE set of figures is that presented in this issue, showing the operating costs in some 47 buildings, in Cleveland, Ohio, all heated with natural gas as a fuel. Most of the records are for private residences and, with the dimensions given, offer an interesting check on the calculated requirements. While natural gas was the fuel used, the heaters themselves were designed, in some cases, for steam heating and in others for hot water, while still others were in the form of warm air furnaces. The paper supplements very nicely the few data already published on this subject.

One of the most significant features of the investigation was the record of high indoor temperatures in so many of the buildings heated. Not only that, but in many cases the high temperatures were distinctly specified and provided for, running from 74° F. as high as 87° F. Here we have confirmation of the general statements so often made that Americans habitually live in over-heated houses. This, too, in a climate that compares favorably for sharp winter weather with that of any of our colder sections.

The most recent researches have shown the most desirable indoor temperature to be 68° F., with a relative humidity of 42%, or as Dr. Hill, of the Chicago division of ventilation, expressed the requirements to be met in testing school equipments: temperature, 68° F.; relative humidity, 42%; air supply, 30 cu. ft. per minute per person; air movement, 2 ft. per second; parts of CO in 10,000, 8; dust count, 100,000 particles per cubic centimeter; bacteria, 12 colonies per three-minute plate.

If this even approximates the ideal, one of the first steps in the impending efforts for the uplift of the art should be a campaign for more reasonable indoor temperatures, for they certainly have a bearing on the practical side of the heating engineer's work.

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OUTSIDE of an association gathering, a discussion of "co-operation among heating engineers" is not, as a rule, taken seriously. "Knocking among heating engineers" would be a more likely subject of debate. This is probably true of other industries in their earlier stages. As a profession gets larger the diversity of interests is very often sufficient in itself to bring about a more liberal point of view on the part of those concerned. The difficulty just now with the heating engineer is for him to realize the extent to which his profession has grown. It is difficult to collect statistics, but it may be easily shown that the profession has experienced an astonishing growth in the past decade. It is high time that the habitual "knocker" took a new view of the situation and got in touch with the big forward movement going on in the trade. It is here, and there is enough glory in it for every man Jack in the profession. Try boosting awhile!

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

CONDUCTED BY IRA N. EVANS, C. E.

59—Recent Data on the Recirculation of Air.

QUESTION: Some time ago, in discussing the economy of recirculating air for ventilating purposes, you reached the conclusion that the apparent economy in the fuel bill would be more than offset by the cost of dehumidification which, you showed, would be necessary if no fresh air were admitted to mingle with the vitiated air. Recently a paper was presented before the heating engineers' society that appeared to show the economy of recirculation of the air. Can you reconcile the conclusions reached in this paper with your statements as referred to?

ANSWER: In considering the paper by G. L. Larsen on "Tests on the Recirculation of Washed Air," which is the one referred to by our correspondent, attention should be directed to the conditions under which the test was made, as these conditions would seldom obtain, at least in elementary schools in large cities. The recirculation of the same air, in that case, would certainly reduce the steam consumption over that in using outdoor air. The intermittent flow of condensation, when the thermostats turn on steam, is due to the preliminary heating of the cast-iron radiators which will condense as much as 25 lbs. per square foot per hour under these conditions. This heat is, of course, given up after the steam is turned off.

The reduction in the condensation when the air is recirculated is undoubtedly in accordance with the facts. The radiators are placed under the windows adjacent and the cold air falling on them is heated and rises to the ceiling where the temperature is anywhere from 10° to 20° higher than at the floor.

The operation of the fan in circulating the air from the ceiling to the floor outlet causes the heat to dissipate and distribute, increasing the temperature adjacent to the direct radiators and equalizing the temperatures at the floor and ceiling.

The writer has used this method of recirculation in high shop buildings. By starting the fan and recirculating the air from the roof to the floor level, the temperature 6 ft. from the floor has been raised 10° without supplying additional heat. The reduction of the temperature under the roof, of course, decreases the radiation of heat to the outside through the roof, thus decreasing the heat requirements.

Following are a few figures giving the conditions as described in the test as compared to what might be expected in a large city school:

This is a high school building evidently situated in an open country space, where, if there were no mechanical ventilation provided at all, probably no serious effects would result. Many of the pupils are shifted at intervals from class to recitation rooms. There are also the usual intermissions of recess and lunch periods; in short, probably a shifting of classes during every hour of the session.

All rooms, both occupied and unoccupied, are interconnected through the recirculation ducts so that the air is diffused through the entire building. It will also be noted that there were only 250 pupils average at the time of the test. The figures show that there are 158,540 cu. ft. of space in the class rooms for the 250 pupils, or over 600 cu. ft. per pupil. If the entire cubical contents of the rooms supplied are taken into account, there are 268,684÷250, or 1,460 cu. ft. of space per pupil. Class room 8 shows 800 cu. ft. of space for the student capacity, or, with an attendance of 16, over 1,000 cu. ft. Class room 10 shows about 500 cu. ft., and, for the actual attendance, 680 cu. ft.

In a class room as arranged for an elementary school, there would be provided 216 cu. ft. per pupil, and the attendance would be the maximum or 40 pupils for 5,640 cu. ft. of space.

In the Larsen test, the air supply was 5,726 cu. ft. for the class rooms occupied or 23 cu. ft. per pupil per minute for the pupils actually in attendance. If the total air supply of 15,000 cu. ft. were taken, it would make 60 cu. ft. per pupil actually in attendance.

THE FIRE RISK A FACTOR.

Another point that is worth considering in this connection is the question of how these return flues to the fan interconnecting the class rooms would affect the carrying of sound, and also the view the fire authorities in a large city would take of the building as a fire risk. Where schools are designed under Massachusetts laws, there are no flues interconnecting and an equal amount of air has to be renewed, as well as supplied.

Referring again to the tests in question, the building is equipped with an air washer capable of handling 30,000 cu. ft. of air per minute and it is only washing 15,000 cu. ft. If this school were in a crowded city, with, say, 60 children per class room and if the pupils were not transferred from room to room and there was no auditorium other than throwing the class rooms together by means of folding doors, the results would be materially different.

The actual air supplied to this school when the amount per pupil and cubic space per pupil are taken into account will be found to be as great, if not more, than that supplied in large elementary schools in cities. With an initial condition of 368,684 cu. ft. of space and with three changes per session, due to leakage and open doors, which would occur when the pupils went to lunch and recess, in five hours the actual air supply would be $(368,684 \times 3) \div (250 \times 5 \text{ hrs.} \times 60 \text{ min.}) = 15$ cu. ft. of actual fresh air per pupil, with no allowance for the removal of used products by the air washer and the induced air supply, due to the small ventilating fan in the attic.

On the whole, it is seen that the ventilation is rather liberal under the conditions named. With less cubic space per pupil and figuring on 400 B. T. U. being given up by 40 pupils, this would make 16,000 B.T.U. per hour to be taken care of in reducing the temperature of the air, or nearly the amount of the radiation of the room to the outside.

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Milwaukee Local Association.

Following are the officers elected at the annual meeting of the Milwaukee Association of Master Steam and Hot Water Fitters, held in Milwaukee, January 7: President, F. H. Meadows: vice-president. Frank Downey; secretary, Edward Metz; treasurer, Fred Kauffman.

LEGAL DECISIONS

When a Contract Is Binding, Despite the Use of a Printed Clause on Business Stationery.

An important decision was recently secured by the B. F. Sturtevant Co., in the Appellate Division of the New York State Supreme Court, in an action against the Fireproof Film Company, the decision being that when a contract between the parties is clearly expressed on a letter sheet of office stationery, which also contains at the bottom thereof, and printed in small type, certain conditions and exceptions not otherwise referred to, such conditions and exceptions may not be deemed a part of the contract.

The action was brought to recover damages for the breach of an alleged contract. The contract was in the form of a "proposal and specifications," submitted by the B. F. Sturtevant Company and which were endorsed as accepted by the Fireproof Film Company.

After work had been commenced, the Fireproof Film Company stated that the acceptance of the contract should have been submitted to the company's board of directors for approval and asked the Sturtevant company to hold off on its work until further advised. Later, the film company cancelled the contract.

After suit had been brought by the Sturtevant company, the claim was made that the film company did not enter into any contract with the plaintiff, inasmuch as the alleged contract was executed without the necessary authority.

After the case was won by the Sturtevant company in the trial court it was appealed to the appellate division and there the principal claim urged for the first time for a reversal of the judgment was that there was no contract between the parties because at the bottom of the first page of the plaintiff's office stationery, upon which the proposal was written, appear the words:

"All agreements are contingent upon strikes, fires, accidents, or delays beyond our control. All prices are subject to change without notice, and all contracts and orders taken are subject to the approval of the executive office at Hyde Park, Mass.," and that, as there was no proof that this approval was given, there was no contract.

The court held that in view of the manner in which this provision is printed upon the stationery of the plaintiff, it cannot be held, as a matter of law, that it was incorporated in and a part of the proposal. The language of the proposal is clear and explicit, and this provision, which is printed in small type, cannot be allowed to change, alter or modify it, unless it was part of the proposal. If, however, this point had been raised at the trial, it would have presented a question of fact to be determined by the jury.

When an offer, continued the opinion of the court, proposal or contract, continued the opinion of the court, is expressed in clear and explicit terms, matter printed in small type at the top or bottom of the office stationery of the writer, where it is not easily seen, which is not in the body of the instrument or referred to therein, is not necessarily to be considered as a part of such offer, proposal or contract.

Payment for Additional Radiation.

A contract to install a heating system in a house consisted of owner's acceptance of a proposal which provided for the installation of 325 sq. ft. of "three col. 38-in. radiators." In an action for a balance claimed to be due under the contract, the owner counterclaimed for the necessary expense of supplying 100 sq. ft. additional radiation subsequently found necessary to supply the requisite amount of heat. As the contractor did not warrant that the amount of radiation specified in the contract would be sufficient to satisfactorily heat the house, it was held that he was not required to furnish, without expense to the owner, the necessary additional radiation.—Miller vs. Winters, 144 N. Y. Supp. 351.

Draft Regulator for Furnaces.

In an action against an hotel for infringement of a patent for the regulation of furnaces the real defendant was the corporation which placed the alleged infringing apparatus in the hotel. The plaintiffs' patents were the McLean patents, No. 817,436, for mechanism, and No. 826,349, for a method for regulating furnaces to secure a "balanced draft" by which the blower and flue damper are automatically and reciprocally controlled by means of the steam from the boiler, with the object of maintaining atmospheric pressure in the furnace chamber. The combination which produces this result and the method of its production amount to a device by which as boiler pressure diminishes or increases the blower speeds up or slows down; if the blower slows, the flue damper correspondingly closes; if the blower speeds, the damper correspondingly opens. How much the damper shall move when the blower slows or hastens is empirically determined when the apparatus is put in place by observing the combustion chamber pressure under varying conditions of fire and air; but when the quantum of movement is determined, the power productive of motion is always the steam in the boiler, operating through machinery unnecessary to describe, directly on blower and flue damper.

To maintain "substantially atmospheric pressure" in the combustion chamber of a furnace (i. e., immediately above the fire bed) cannot, the federal district court, S. D., New York, said, be a desirable end—in and of itself. It must be indicative of more important things. The fact is that when the pressure is atmospheric, or substantially so, immediately above the furnace fire bed, there is no great suction of cold air into the furnace when the door is opened; nor, on the other hand, does a tongue of flame lick out into the fire room when opportunity offers. If the cold air does not enter above the fire bed, nor the flame shoot out, it is evidence that combustion is progressing with evenness, and the heated gases are progressing without undue speed through tubes and baffles toward the chimney exit where is situated the flue damper. Thus the maintenance of atmospheric pressure is merely a brief way of expressing the maintenance of favorable and economical conditions of combustion.

The district court held that the patents were not anticipated and were infringed, 226 Fed. 779. This was affirmed by the Circuit Court of Appeals on the opinion of District Judge Hough, the court also pointing out that the Peck British patent of 1893 came short of doing what McLean's patent did, namely, securing a range of variations which would operate efficiently under substantially all the varying rates of combusion which may call for control.—Engineer Co. vs. Hotel Astor, C. C. A. 226, Fed. 949.

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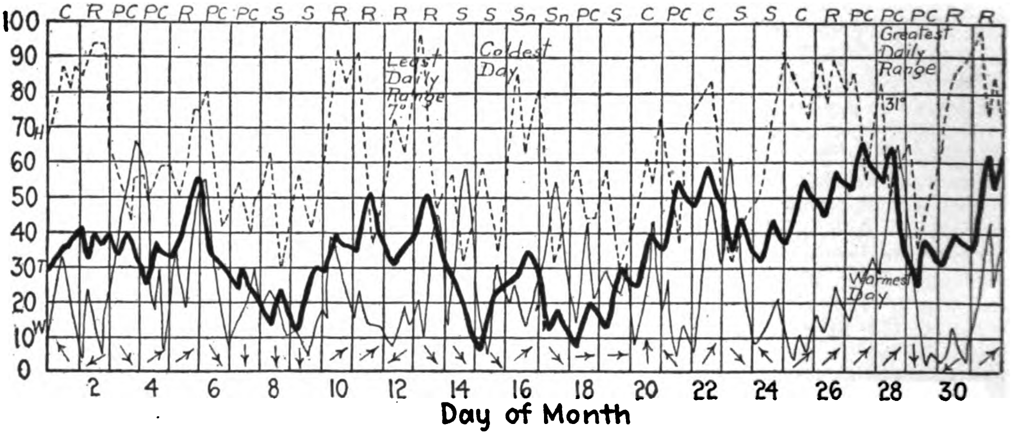
Articles from Trade Papers Now Catalogued by the New York Public Library.

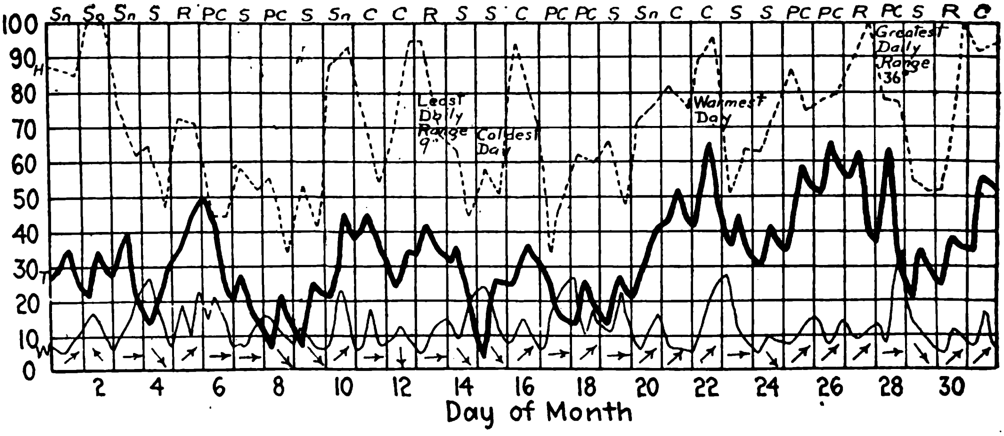
Announcement is made by the New York Public Library that the 200 periodicals on file at the library are all examined as soon as received and index cards for the most important articles are made and filed in the library's catalogue. The library states that it is also glad to lend current periodicals for a brief period. Among the periodicals taken by the library is THE HEATING AND VENTILATING MAGAZINE.

The Weather for January, 1916

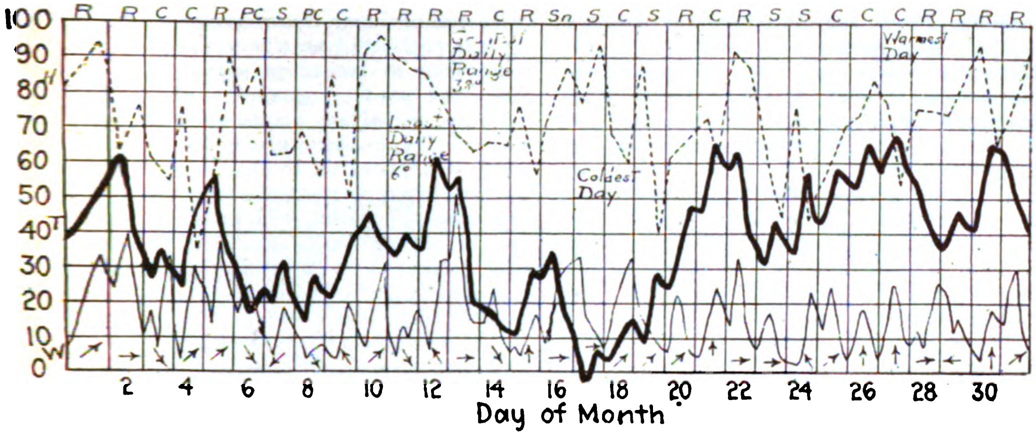
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	66	66	69	62	65
Date of highest temperature	27	22	27	27	1
Lowest temperature, degrees F.	7	4	—3	—6	—4
Date of lowest temperature	15	15	7	13	13
Greatest daily range, degrees F.	31	36	38	45	48
Date of greatest daily range	28	28	13	5	12
Least daily range, degrees F.	7	9	6	5	6
Date of least daily range	12	13	11	18	30
Normal temperature for month, deg. F.	35.4	33	38	28.8	34.1
Normal mean temp. for month, deg. F.	30	27	30.7	23.7	31
Total rainfall, inches	1.08	1.23	3.51	4.84	8.53
Total snowfall, inches	0.7	4.7	1.3	2.7	2.7
Normal precipitation, this month, inches	3.79	3.82	2.87	2.0	2.27
Total wind movement, miles	15016	8755	9898	11551	12248
Average hourly wind velocity, miles	20	11.8	13.3	15.5	16.5
Prevailing direction of wind	S.W.	S.W.	S.W.	W.	S.
Number of clear days	7	9	6	10	8
Number of partly cloudy days	10	7	2	4	3
Number of cloudy days	14	15	28	17	20
Number of days on which rain fell	11	9	15	22	16
Number of days on which snow fell	2	5	1	4	4
Snow on ground at end of month, inches	—	—	—	—	—



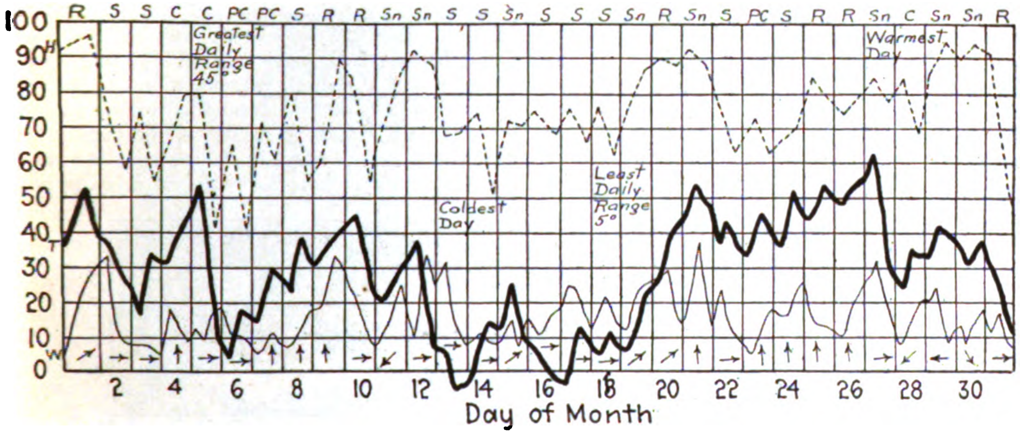
RECORD OF THE WEATHER IN NEW YORK FOR JANUARY, 1916.
Hourly Observations of the Relative Humidity are Plotted on this Chart.)



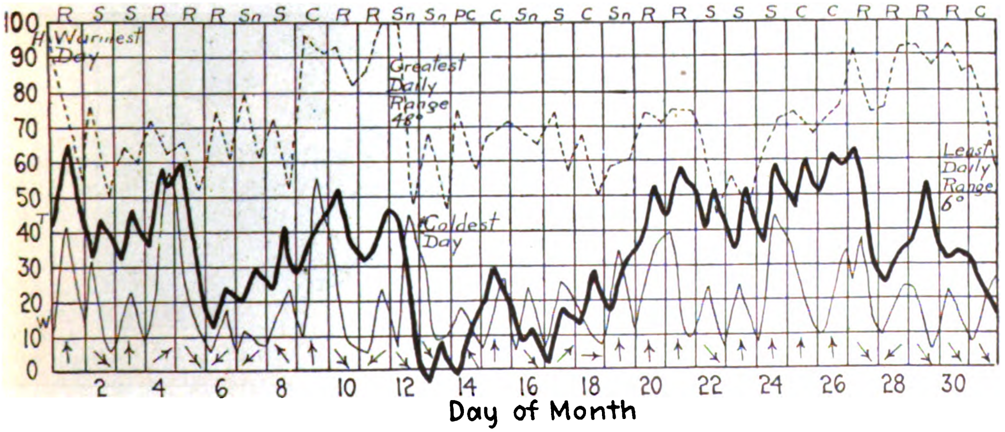
RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1916.



RECORD OF THE WEATHER IN PITTSBURGH FOR JANUARY, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1916.

Plotted from records especially compiled for The Heating and Ventilating Magazine, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

Testing Plant for International Boilers.

The many points to be covered in the testing of boilers are indicated in the accompanying views of the testing plant maintained by the International Heater Co., at Utica, N. Y. Fig. 1 represents a test in progress on a round boiler burning soft coal. The tester at the left is observing the gas analysis, while an engineer on the right is taking readings from a pyrometer. It is frequently necessary to take 21 different readings at 15-min. intervals for periods of from 9 to 48 hours.

The water used is, of course, all weighed In Fig. 2 may be seen a long gauge which extends the length of the tank. This gauge indicates the weight of water in pounds at any given point. Each tank is thus equipped. To guard against any undetected leakage through valves that might affect results, each pipe has double valves, A, A, with a small pet cock between. When both valves are closed and the pet cock opened, any leakage due to the tank or from the tank toward the boiler would be immediately detected.

Compressed air is used to force the water from the tanks into the boiler and the gauge, B, allows conditions to be adjusted so as to overcome the boiler pressure. As the temperature of the feed water is an important factor, a thermometer, C, always indicates that.

It would not be satisfactory to determine the steam pressure of a boiler being tested with the ordinary steam gauge. The pressure is registered on a mercury column, D, graduated to record pressures down to 1 oz. But while a gauge of that kind is accurate for steam pressures, it cannot be depended upon to register the draft pressure of a boiler or smoke flue. Therefore special instruments built for this purpose are used (E) which will record a pressure as low as 1/1000-in. of water. When it is stated that 1-in. of water represents a pressure of 3/5-oz., it will be seen how finely these instruments are adjusted.

A barometer and hygrometer, F and G, register atmospheric conditions which have to be reckoned with in making tests. The next instrument, H, is the pyrometer, connected with the four thermo couples which may be seen extending into the boiler. These couples are connected by insulated wiring through a 4-point switch to the pyrometer. The heat sets an electric current in action, which increases or decreases in force in exact ratio to the temperature. The sensitiveness of these instruments will be appreciated when it is stated that the heat of a match may be recorded with practically the same accuracy as the temperature of the fire in the boiler.

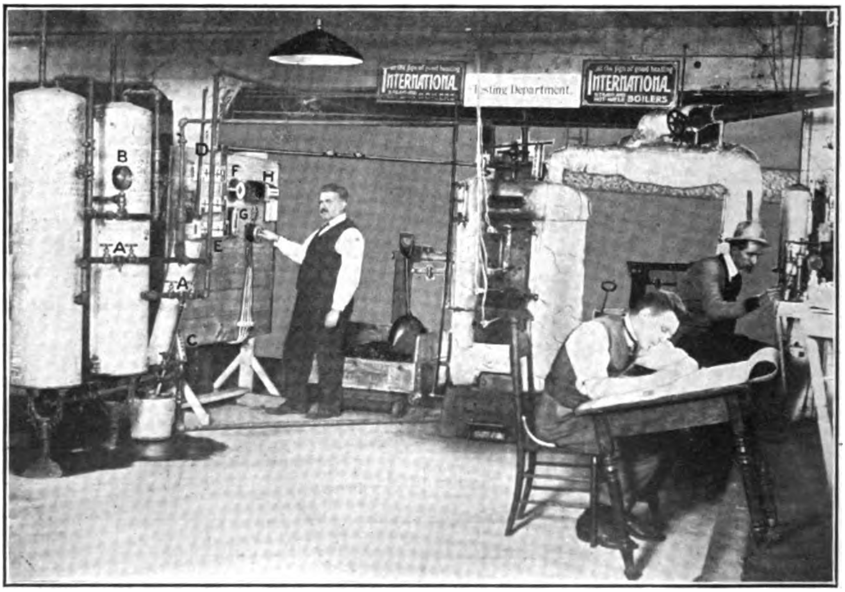


FIG. 1.—TEST IN PROGRESS ON ROUND BOILER BURNING SOFT COAL

All the coal is weighed, as well as all ash and residue. The smoke and gases passing up the chimney are trapped into a flue gas sampling tank, I. At the close of the test, they are conducted to the gas analysis machine, K, to determine how much carbon dioxide, carbon monoxide, etc., are present. During the test, at intervals, the gases are also taken directly to the analysis machine and analyzed. An excess of carbon monoxide means that 1 lb. of coal will convert only 3 pints to 2 quarts of water into steam, while if the gases show a proper proportion of carbon dioxide, the amount of steam obtained by burning 1 lb. of coal may be from 1 to 1 1/5 gals. of water.

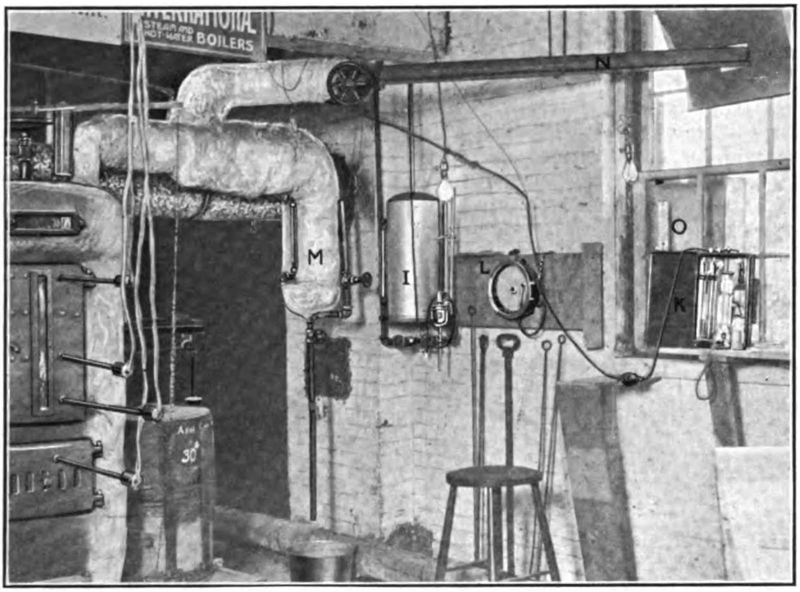


FIG. 2.—NEAR VIEW OF SEPARATOR, RECORDING THERMOMETER AND GAS ANALYSIS MACHINE.

Still, another interesting instrument used is the recording thermometer, L, by which a record is obtained of the flue gas temperatures during the entire period of the test. The pipe passing through the window is the steam pipe. In order to be sure that only dry steam passes through it, a steam separator is placed at M (Fig. 3) in which the water is separated from the steam. If this were omitted and a boiler incorrectly designed, the tests might show a false result, since it is easy for the water to be picked up by the escaping steam and carried along with it. This may be the explanation of apparently high evaporative results sometimes secured in boiler tests.

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Automobile 'Buses To Be Heated.

As a striking evidence of the growing public demand for comfortably-heated 'buses and taxicabs comes the announcement that the Fifth Avenue Bus Co., New York, has placed an order for 240 Type B Perfection heaters, made by the Perfection-Spring Service Co., Cleveland, O. This heater was illustrated and described in The Heating and Ventilating Magazine for December, 1915. Exhaust gases from the engine are used for heating.

Ventilation of Chicago Schools.

Referring to an item published in the February issue to the effect that from ten to fifteen letters per week had been received by Dr. John Dill Robertson, from parents and teachers, complaining of the ventilation in the public schools of Chicago and that the letters were to form the basis of a special investigation by the engineering department of the Board of Education, attention is called by a correspondent to the fact that there are more than 275 school buildings in Chicago, averaging 16 rooms each, or nearly 4,500 rooms, and ten or fifteen complaints a week in as large a number of rooms should be considered very small, especially when it is considered that there is such a wide difference of opinion as to the proper method of ventilating school rooms.

The statement by itself, continues our correspondent, might lead unthinking people to jump to the conclusion that the Chicago schools are badly ventilated, which is not the case, as the system of ventilation in the Chicago schools is second to none in the United States. The correspondent's personal opinion is to the effect that if the ventilating systems are properly operated there need be no actual complaints from improper ventilation.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New Secretary for the Heating Engineer's Society.

J. J. Blackmore, for two years secretary of The American Society of Heating and Ventilating Engineers, has tendered his resignation, to take effect April 1, 1916. Mr. Blackmore will be succeeded as secretary by C. W. Obert, at present assistant secretary of the American Society of Mechanical Engineers and formerly on the editorial staff of the *Engineering Record.*

During Mr. Blackmore's incumbency the society has made rapid strides forward and in April last year commenced the publication of a society Journal which has done much to widen the interests of the membership in the work of the organization.

C. W. OBERT.
New Secretary of The American Society of Heating and Ventilating Engineers.

Mr. Blackmore will return to the commercial field, taking up the management of a new boiler and heater department at the J. L. Mott Iron Works, New York. The company's former boiler department, of which Mr. Blackmore was manager for many years, was taken over, it will be recalled, by the United States Radiator Corporation at the time of the organization of that company a few years ago. The new department will market the line of boilers and radiators previously manufactured by the Federal Radiator Company, which was organized to take over the line of boilers and radiators made by the Novelty Iron Works, of Canton, O. It is expeted that the J. L. Mott Iron Works will have its new product ready for the market by the first of June.

C. W. Obert, the new secretary, is known to many of the members. He has made an enviable record in connection with the editorial management of the Journal of the mechanical engineers' society. He had direct charge of the preparation of the publication of the boiler code recently promulgated by that society. This experience, coupled with his previous work for the *Engineering Record,* will go far towards insuring his success in the broadened field of activities which the society has entered. Mr. Obert will be at headquarters beginning April 1.

New York Chapter Takes Up the Problem of "Co-operation Among Engineers."

The neglected opportunities of the heating and ventilating engineer to further his interests and those of the profession, came in for some sharp comments at the February meeting of the New York Chapter, which took the form of a complimentary dinner in the rooms of the Building Trades Employers' Association, in New York, February 28. In the absence of President W. H. Driscoll, Vice-President Arthur Ritter occupied the chair. The speakers were W. M. Franklin, who is chairman of the committee in charge of the society's publicity campaign; Charles F. Hauss, of Milan, Italy, who is a charter member of the society but who has spent the last ten years abroad; and Frank K. Chew.

Mr. Franklin spoke first on the broad aspects of the subject, stating that the great European war has already taught us the necessity of developing our own resources to the point where we will be as little dependent as possible on Europe for either raw materials or finished products. He spoke particularly of the need of this country's manufacturing its own dyes and chemicals. In event of our being plunged into war, so that such imports were cut off, this country, he said, would be seriously embarrassed, if we were not able ourselves to turn out all the necessities of life. Mr. Franklin said he saw protective legislation coming. Most of the country's present prosperity is due directly or indirectly to war orders and at the close of the war measures will have to be taken to avoid a business panic. We should adjust ourselves, therefore, to a perpetuation of the new industries created as a result of the war.

The engineering field, continued the speaker, has never been appreciated as it is to-day. Engineering is the greatest single element in our modern civilization. Engineering is fighting the war to-day and it is an engineering war. Moreover, the term of engineer is being so widely applied that it has come to include every trained worker.

The heating engineers are not availing themselves of the opportunity now presented to them of building up an effective and powerful organization. Effort is the price of accomplishment and every man has got to do something. If we are to take advantage of the influence the war is having upon our industries, we must put our shoulders to the wheel. We must get out to the meetings. We must disseminate knowledge of our art.

All of the large national engineering societies are recognized and are represented on the government's advisory board for military preparedness. But the heating and ventilating profession is not recognized in the make-up of this board. Yet the fundamental problem in the construction of submarines, for instance, is that of the ventilation and heating of such vessels.

Then there is a great wave of interest in sanitary matters and sanitarians are largely getting the credit for the advances in our field. The other engineering organizations do not do things that way. They go to the colleges and suggest lines of research.

By promoting the interests of the profession the engineer promotes his own individual interests and the way to start promoting is to get out to the meetings, to suggest lines of effort, to write papers and to start discussions.

Mr. Hauss, who followed Mr. Franklin, is the president of the American Chamber of Commerce in Milan. He said that in continental Europe everybody consults the engineer when there is work to do requiring such services. He said not one of the things that most impressed him on his return to the United States was the tremendous waste on every hand. Overheating, he declared, was one of the principal forms of waste and it was difficult at first for him to become accustomed to the high indoor temperatures.

He predicted a wide market in Europe after the war for American products. Many of the mines, he said, are already or will be destroyed, although in connection with agricultural and similar pursuits, he thought Europe would recover comparatively quickly. He expects to see the cancellation this year of many so-called war orders.

Speaking of the use of heating apparatus in Italy, he said the usual types could not be operated generally owing to the high cost of fuel. The price of bituminous coal in Milan, he said, was $42.00 per ton, and that of anthracite coal, $50.00 per ton.

Frank K. Chew, who was then presented, emphasized the interesting character of the lectures and discussions that had marked the meetings of the New York Chapter and stated that the members were neglecting their own best interests when they missed them. He paid a high tribute to the retiring secretary of the society, J. J. Blackmore and amid applause, expressed the good wishes of the members that would go with Mr. Blackmore in his new field of work.

Mr. Blackmore, who was present, after expressing his thanks for the reception accorded him, stated that his two years' association with the members as Secretary had been an exceedingly pleasant one and that while he was leaving active work in the society, he would, of course, retain his membership and would continue to do what lay in his power to advance the society's interests.

New members were elected to the chapter as follows: A. E. Carpenter, A. K. Ohmes and D. R. Ludlow.

In response to a request from the chairman for suggested topics for discussion, the topics of "legal decisions," "ventilation of subways," and "contracts and guarantees" were suggested. It was voted to dispense with an annual dinner of the chapter this year, and instead to continue to have the chapter meetings in the form of dinners, the members to be the guests of the chapter.

Illinois Chapter Hears Lecture on Fire Prevention.

Fire prevention, with especial reference to the work of the Underwriters' Laboratories of Chicago, was the principal topic for discussion at the February meeting of the Illinois Chapter, held February 14 at the Morrison Hotel, Chicago. J. E. Latta, of the Underwriters' Laboratories, was the speaker and his remarks were illustrated by moving pictures which added greatly to the interest of the meeting. The work of the laboratories, it was shown, includes experimental tests to determine the fire hazard in various kinds of building materials and the methods of making these tests were fully described by Mr. Latta. The experimental plant is valued at $250,000 and is a gift from the insurance companies to develop methods for reducing the fire hazard.

The lecture followed a dinner at the Hotel Morrison. Before the speaker was introduced the Illinois Chapter took formal action in extending an invitation to the American Society of Heating and Ventilating Engineers to hold its mid-summer meeting in Chicago. It was pointed out that it is ten years since the society came to Chicago.

President Harry M. Hart, of the society, announced that the meeting of the Chicago Commission on Ventilation, to be held February 22, would take up hospital ventilation.

The following were elected to membership in the chapter: John J. Haines, George H. Heinrich, John Howatt, George D. Hoffman and H. K. Gilson.

Massachusetts Chapter.

General topics pertinent to the trade were discussed at the February meeting of the Massachusetts Chapter, including reports from those in attendance at the society's annual meeting in New York in January. It was the consensus of opinion that the business outlook is brighter than for months past and that there were many good specifications for heating and ventilating installations recently completed.

Michigan Chapter Organized.

Starting with a membership of thirty-five, one of the best initial showings made by any chapter, the Michigan Chapter of The American Society of Heating and Ventilating Engineers was formally organized at the Detroit Club, Detroit, Mich., February 4. Officers were elected as follows:

President, Professor John R. Allen, of the University of Michigan, Ann Arbor; vice-president, Fred R. Still, American Blower Co., Detroit; treasurer, Edward M. Harrigan, of the Harrigan & Reid Co., Detroit, and secretary, William F. McDonald, heating engineer, Dime Bank Building, Detroit.

The Michigan Chapter's first regular meeting was held March 8.

The chapter has already laid plans to induce The American Society of Heating and Ventilating Engineers to hold its forthcoming semi-annual meeting in Detroit.

Ohio Chapter.

Temporary officers of the Ohio Chapter, which was recently organized, have been elected as follows: President, William M. Kingsbury; secretary, Frank G. Phegley; treasurer, F. H. Valentine. The headquarters of the chapter are in Cleveland.

NATIONAL DISTRICT HEATING ASSOCIATION

New Date for Annual Meeting.

Owing to the fact that the National Electric Light Association has selected the same week for its meeting as had been previously chosen by the National District Heating Association, a change has been made in the date for holding the district heating association's convention from May 22-25 to May 16-19, bringing it one week earlier. As already announced, New York will be the convention city this year, headquarters being at the Hotel Martinique.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Annual Convention of the Wisconsin Association.

A successful year of effort, accompanied by a 7% increase in membership, was reported at the fifth annual meeting of the Wisconsin State Association of Master Steam and Hot Water Fitters, held in Milwaukee, Wis., January 20. Many of the members are also affiliated with the Wisconsin Master Plumbers' Association, which was in session in the same city.

In further reviewing the work of the year, President Edward Grassler mentioned the accomplishments of the National Association in completing the standardization of flanges and flanged fittings, and in rendering service to its members in educational and legislative matters. The report of the secretary showed an increased balance on hand.

The following officers were elected: President, James Schmollen, Racine; vice-president, Albert Luebke, Milwaukee; treasurer, Fred Kauffman, Milwaukee; sergeant-at-arms, Otto Biefeld, Watertown; secretary, Frank H. Meadows, Milwaukee.

Following the convention an association banquet was given the members and guests at the Republican House. The speakers included Mayor Bading, of Milwaukee; Judge J. E. Karel, and Attorney William Zimmer. Two surprise presentations were features of the banquet, one being in the form of a gold watch, given to Albert Luebke, former president of the Milwaukee local association, and the other, an automobile luncheon case, presented to Fred Kauffman, the newly-elected treasurer. Over 100 guests were in attendance.

The association is planning to hold a midsummer convention in Fond du Lac some time in July.

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Central Supply Association.

At the seventieth regular meeting of the Central Supply Association in Chicago, February 23, a report by Secretary Paul Blatchford, on the cost of doing business during 1915, covering over 30 jobbing points, showed the average cost to be 15.77%. A summary of the advances in supplies, material and fixtures was also presented. In the afternoon an address was delivered by Philip S. Post, general counsel of the International Harvester Company, dealing with the present chaotic conditions of licenses, taxes and requirements for doing business by foreign corporations in the various States, and concluding with an analysis of the Federal Trade Commission Act and the Clayton Law.

◆

Institution of Heating and Ventilating Engineers.

The annual meeting of the (British) Insitution of Heating and Ventilating Engineers was held March 8, at the Holborn Restaurant. A paper was presented by A. H. Barker, B. A., B. Sc., and M. Kinoshita on "Experiment in the Flow of Air Up a Hot Flue." The new president of the institution, Sam Naylor, made his address, which was followed by committee reports and other business.

◆

Class Dinner of the New York School of Heating and Ventilating.

Arrangements have been made for holding a class dinner of the New York School of Heating and Ventilating, which has been meeting Monday evenings in the World Building, under the direction of Charles A. Fuller. The dinner, which is coming to be an annual event, will be conducted this year by the alumni of the class. It will be held March 13 at Stewart's Restaurant, 30 Park Place, the committee on arrangements being A. D. Sage and A. D. Hoxie. Tickets will be $2.

Features of the Farnsworth Line of Heating Specialties.

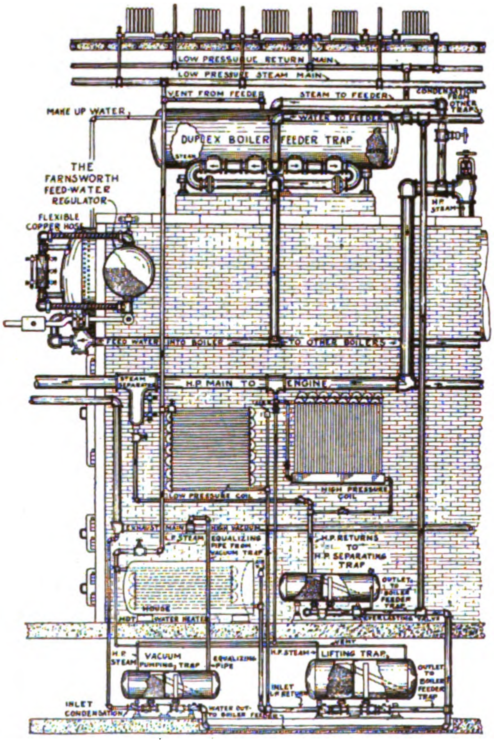
A comprehensive idea of the different uses of the Farnsworth line of steam specialties may be gained from the accompanying typical installation, showing the front half of a power boiler and several kinds of Farnsworth apparatus, connected to handle condensation and make-up water correctly under the varying conditions involved in the average power and heating plant; eliminating the use of pumps, receiving tanks and their several auxiliaries, as well as lubricating oils and packing.

The Farnsworth duplex boiler feed trap, the principal apparatus used, is shown on top of the boiler and not only feeds all the condensation coming back from the heating system, and the several traps, but also feeds the cold water make-up into the boiler automatically, eliminating boiler feed pump injectors, or any other of the usual processes. The advantage of this trap, it is pointed out, is that it is absolutely automatic and is a receiving tank as well. Another point made in its favor is that it does not require as much steam as a pump, for the reason that 1 cu. ft. of steam displaces 1 cu. ft. of water, while with the steam pump the steam cylinder is usually twice the size of the water cylinder, and there is also the friction and head on the feed line between the pump and the boiler.

The tank is divided into two chambers, one chamber being always open to receive condensation, while the other is under pressure feeding the water into the boiler.

It will be noted that all condensation from radiators or heated apparatus that are above the water line of the boiler feeds directly into the boiler feed trap, while the condensation from the heated apparatus, etc., below the water line of the boiler, has a special trap for each condition. The condensation from the steam separator and the high pressure coils drains into a high pressure separating trap, and its contents are discharged up into the boiler feed trap. The condensation from the low pressure coils and from the coils in the hot water heating tank, or tanks, requires a lifting trap. The condensation flows into the lifting trap and by the attachment of a high pressure steam connection, when the lifting trap tilts down when full of water, it opens the high pressure steam and closes the vent and pumps the water up into the boiler feed trap. As the contents from the lifting trap are discharged, the tank reoscillates, closing the high pressure steam valve and opening the vent valve. Then the trap again receives low pressure condensation.

The same lifting trap can be used as a vacuum pumping trap for draining condensation from lines carrying a high vacuum. When the trap is filled, it tilts down, closing the equalizing pipe and opening the high pressure steam valve, which pumps the condensation up into the boiler feed trap. As the trap is emptied and re-oscillates, the equalizing valves open and the high pressure valve closes, and then the trap begins to fill with condensation again.



TYPICAL HEATING INSTALLATION SHOWING USE AND LOCATION OF FARNSWORTH SPECIALTIES.

The piping connections and other features, it should be stated, are not drawn to scale.

The Farnsworth system is made up of devices all bearing the name of Farnsworth and manufactured by the F. C. Farnsworth Co., New York. One of the principal features mentioned in favor of this system is that it retains the heat units in the condensation by the closed system method. The pressure of the condensation from high pressure steam mains is not allowed to lower so that the only heat units lost are those required in the heated apparatus and those lost in the pipe lines.

In addition to the conditions stated above, if there is condensation under high or low vacuum to be taken care of, the Farnsworth vacuum trap is designed to collect, and with high pressure steam connection, to pump such condensation into the boiler feed trap. Also a meter trap will indicate how much steam is required to heat any heated apparatus and will also pump the condensation back to the boiler feeder. In addition, the Duplex boiler feed trap will collect condensation from low pressure heating systems where vacuum return line valves are used on each radiator. In that case, the condensation and air is all fed into the boiler feeder. Then the air is separated off to the sewer and the condensation is fed into the boiler, eliminating the vacuum pump.

◆

Consolidated Engineering Company Branches Out As Manufacturer of Fans and Blowers.

All the land, buildings, tools, machinery and equipment formerly owned by the Massachusetts Fan Company, Watertown, Mass., a suburb of Boston, has been purchased by the Consolidated Engineering Company of Chicago, which has commenced the manufacture of fans, blowers, and heater equipment, as formerly made by the Massachusetts Fan Company.

John E. Anderson, for the past 24 years a ventilating engineer and for the past seven years with the B. F. Sturtevant Co., Chicago office, has been appointed sales manager in charge of the Massachusetts blower department and the Kinealy air washer.

The manufacture of the Kinealy air washers will be transferred from the Chicago factory to the Watertown plant, and complete blower equipment and air conditioning apparatus will be built at the Watertown plant in the future.

The Consolidated Engineering Company is building a new factory in Chicago at 28th Place and Shields Avenue, which will more than double the capacity of its present factory at Jackson and Canal Streets. The manufacture of vacuum valves and heating specialties such as pressure reducing valves, pump governors and steam traps, will be carried on at the Chicago factory, while some of the heavier apparatus will be built at the Watertown plant.

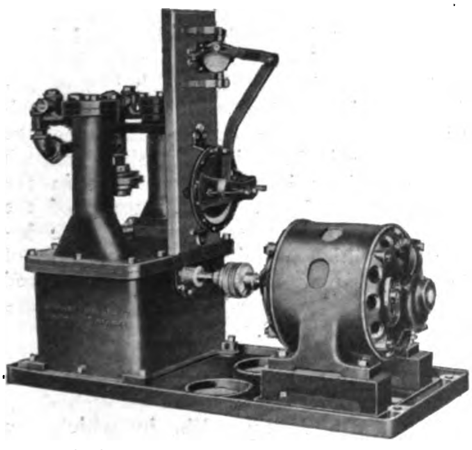
The acquisition of the Massachusetts Fan Company places the Consolidated Engineering Company in the unique position of being the only manufacturer in the vacuum heating field that manufactures everything required in the heating and ventilating of a building, with the exception of the boiler, pipe and fittings. The company's line now includes the Van Auken system of vacuum heating, Van Auken steam heating specialties, Thermograde modulation system of heating, Kinealy air washers and Massachusetts blowers.

NEW DEVICES

Powers Electric Motor-Driven Vacuum Pump.

To supply the demand for a high-class electric motor-driven vacuum pump for air line steam heating systems a new design has been brought out by The Powers Regulator Co., Chicago, Ill., which is described as direct-connected, noiseless, automatic and efficient. It will be noted that the pump and motor are both mounted on one base, direct-connected with a flexible coupling. The apparatus may be placed on a foundation or on wall brackets, as preferred, while the controller may be mounted on the pump, as shown, or separately. The worm and gear are of hardened steel and run under oil in the crank case. Automatic lubrication is provided, including that for the pistons.

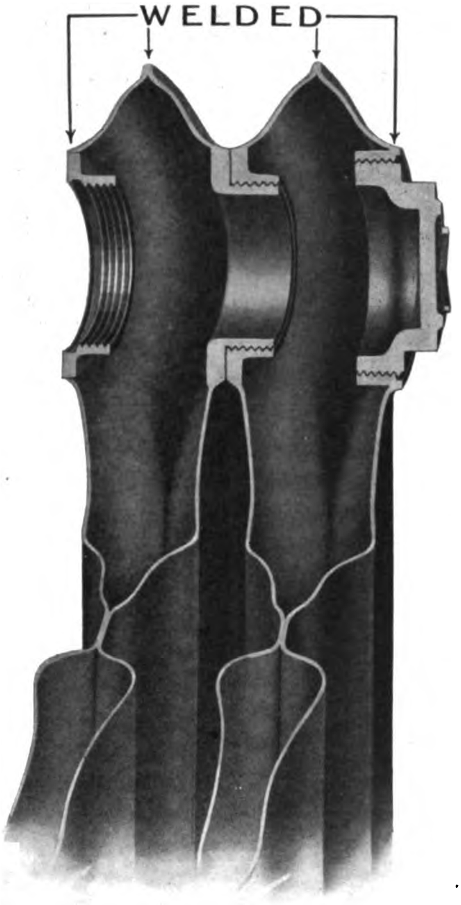
The controller used with this pump, consisting of pneumatic governor and switch, has been standard with the company for years. It is designed to operate on a vacuum variation of 4 in. Further details of construction are contained in the company's Bulletin 135.



NEW TYPE OF VACUUM PUMP.

The New Pressweld Sheet Metal Radiator.

The accompanying view shows the construction of the new Pressweld "alloy" sheet metal radiator, which, as announced last month, has been placed on the market by the American Pressweld Radiator Corporation, Detroit, Mich. This radiator is made up of uniform sections, each section consisting of two plates of heavy gauge radio alloy sheet metal, made especially for this purpose, stamped out by presses and then united by a special welding process. The sections are joined with a special right-hand nipple top and bottom. This, it is stated, is one of the valuable features of this radiator, making it possible to easily add sections or to reduce the number of units at any time. The quickness with which the Pressweld radiator heats and cools, due to its thin surfaces and their



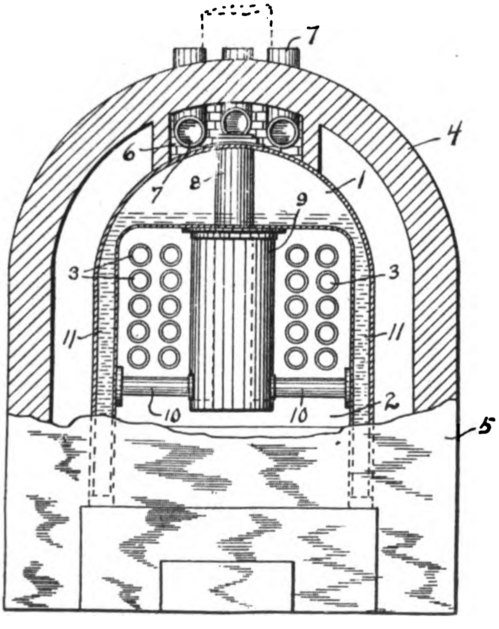
CONSTRUCTION OF PRESSWELD SHEET METAL RADIATOR.

lightness in weight, are also emphasized. In a recently-completed building, for instance, the aggregate weight of cast-iron radiators is 400 tons, while the use of the Pressweld type will reduce the weight to 100 tons.

Following are the officers of the company: President, Martin F. Millard; vice-president, Ernest Snell; treasurer, Ralph P. Peckham; secretary, John A. Irwin; general manager and engineer, Frank J. Singer; assistant manager, D. P. Murphy; superintendent, George W. Curtis.

New Patented Combustion System.

A recent patent, granted to Michael J. Carney of Kewanee, Ill., relating to a system of combustion applicable to any boiler or furnace for industrial or domestic purposes, discloses an interesting type of down-draft design. The feature of the device is a system of introducing all or part of the air necessary for combustion, depending on the nature of the fuel, directly over the fuel bed, and of preheating and expanding this air supply with waste heat from the flue gases by passing it through ducts in the flue gas passages whence it is led through the steam and water spaces of the boiler into the furnace.



NEW SYSTEM OF COMBUSTION FOR BOILERS OF FURNACES.

The rarer air, it is claimed, is thus conditioned to promote an intimate and thorough intermingling of the combustible gases with the supporter of combustion, at the moment of their distillation from the fuel, as this is considered necessary for efficient combustion. The theory is advanced that air directed downward over the burning fuel tends to hinder, by the direction of its flow, incompletely consumed gases from passing prematurely out of the incandescent and flaming zone of the fire, incidentally supplying a surplus of oxygen to complete the process of burning.

Figures from a test of eight hours showed an efficiency of 68.28 per cent., assuming dry steam, but corrected for moisture in the coal, with a load of 7/8 rated capacity of boiler, using Eastern test coal. With air supplied both over and under the fire the test revealed exceptionally easy steaming qualities for the boiler and good regulation.

An effort was made to approximate good working conditions rather than extraordinary test conditions to show average results for the system without special efforts and constant attention.

This system is based on a well-known axiom of combustion which has been a prolific source of experimentation among inventors and combustion experts in recent years, resulting on the whole, however, in a remarkable dearth of practical schemes for the reduction of the valuable principles involved to a workable basis.

Some of the results so far demonstrated are a high efficiency at every phase of the variable loading under ordinary working conditions, ease of control, increased steaming capacity and a more smokeless combustion for boilers equipped with the system.

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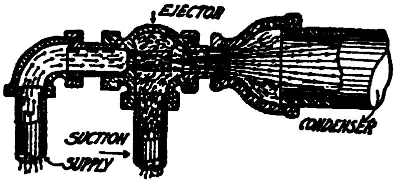
Trade Literature.

Kerner Built-in-the-Chimney Incinerator is the subject of a newly-issued folder describing this equipment, which is manufactured by the Kerner Incinerator Co., Milwaukee, Wis. It consists of a patented arrangement of grates built into and forming a part of the regular chimney (usually the kitchen chimney) in which is consumed by burning all household refuse, including garbage. The refuse and garbage reaches the incinerating chamber through a hopper door in the kitchen or in the other rooms above. The feature of the system is the by-pass grate and the by-pass flue, which permit a free circulation of air. In this way combustion is induced from the top downward so that the odorous gases are consumed.

Moline Heat Everywhere is the title of a new general catalogue published by Moline Heat, Moline, Ill., in which the

Moline system of heating is discussed in a clear and unusually readable manner. The catalogue is handsomely prepared and bespeaks to a degree the confidence of the manufacturers in the merits of this system. After presenting in chronological order the methods used during the evolution of heating, a description is presented of hot air furnace heating, ordinary steam heating, hot water heating and, finally, of vapor or vacuum heating. Under "Essentials of Good Heating," are taken up the matters of separate regulation for each room, noiseless operation, and the use of packless radiator inlet valves. Regulation is also discussed and the conclusion reached that Moline heat fulfills every requirement.



CONSTRUCTION OF MOLINE EJECTOR.

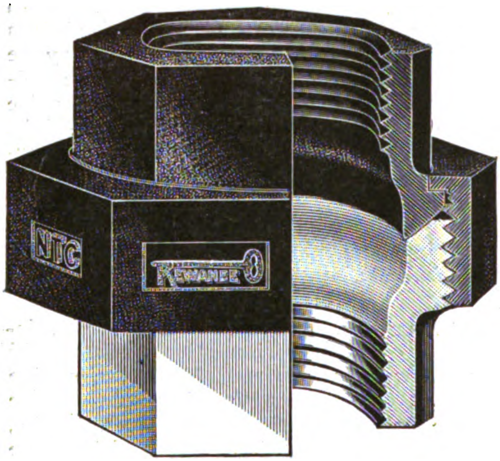
The various devices used with this system are then described, including the Moline ejector, Moline, condenser, Moline air relief valve, and Moline vacuum valve. The reader is given an explanation of their operation from the time the fire is started. The supply valves have a patented restrictor sleeve in the form of a round cylinder, provided with vertical slots. As the valve opens the slots become uncovered, admitting the vapor. The ejector and condenser arrangement for the removal of air is set at the end of the supply pipe and is attached also to the return pipes. This arrangement keeps the ends of the main supply pipes open to the atmosphere so that only a slight pressure at the boiler causes the air to flow out of the radiators and piping. The fire is regulated by the Moline sensitive damper regulator, the construction of which is also illustrated and described. as are also the Moline seals for separating the water of condensation from the steam and returning the condensation to the boilers, when necessary, under pressure. Special attention is called to the company's service department, which is prepared to furnish plans and specifications for the installation of Moline heat. The company guarantees plans and specifications bearing the Moline heat seal. Size 8½x11 in. Pp. 48. Separate catalogues published by the same company treat of "Moline Heat as Applied to Combined Heating and Ventilating Plants," "Moline Heat for Large Buildings, Factories, Etc., Using Live or Exhaust Steam" and "Moline Heat for Central Station or Municipal Heating Plants."

Bi-Calky Fans and Blowers, featuring the Bi-Multi fan wheels, is the subject of a new circular issued by the Bicalky Fan Co., Buffalo, N. Y. These fan wheels, it is stated, are built exceptionally strong and are guaranteed to stand up and not rack under the heaviest work to which fans are subjected. The circular includes capacity tables for ducts 200 ft. long and with a maximum velocity in the duct of 1,800 ft. per minute. These tables were compiled after numerous tests on various-sized fans and the company states that they may be relied upon. They show remarkable efficiencies. There is also included a price list for full-housed and ⅞-housed Bi-Multi fans. The company is also the manufacturer of the Bicalky planing mill exhauster, Bicalky propeller fan and the Bicalky roof fan ventilator, which are also mentioned and illustrated in the circular. Size 3¼x 6¼ in. Pp. 10.

Centrifugal Pumps for all purposes, including condenser circulation, general mill and power plant service, for motor, engine or belt drive, are now being built by the Wheeler Condenser & Engineering Co., Cartaret, N. J., and are described in the company's new bulletin, No. 108-A. These pumps are of the single-stage, double-suction, split-casing type, for heads from 0 to 300 ft. Special attention is called to the testing facilities in the Wheeler hydraulic laboratory and a short description of foundry methods is given. Among the designs of pumps shown, several are of particular interest, such as a combined motor and geared turbine-driven centrifugal pump, and a typical complete surface condenser auxiliary, with geared circulating pump direct-connected to a turbo air and condensate pump driven from a common turbine. Size 6x9 in. Pp. 34.

Valve World for February, 1916, the monthly periodical of Crane Co., Chicago, Ill., continues the "Non-Technical Chats on Iron and Steel and Their Applications to Modern Industry," by L. W. Spring, the company's chief chemist and metallurgist, this month's installment taking up the discussion from making of pig iron in the blast furnace. The article is devoted mainly to a description of the metallographic method of classification and classification by chemical analysis and physical tests.

The Whole "Kewanee" Family, embracing all Kewanee specialties manufactured at the Kewanee Works of the National Tube Co., Pittsburgh, Pa., is the subject of a comprehensive catalogue giving detailed information regarding this line. The catalogue opens with a "little history," telling how the idea developed of making a union with a brass-to-iron thread connection, to take the place of a flange union. It was well-known that an iron-to-iron thread connection would ultimately rust together, but the brass-to-iron thread connection will not rust together, and can be disconnected and reconnected almost indefinitely. This, in brief, is the principal feature of the Kewanee union, although other features are that it has no inserted parts, while each separate union is subjected to a compressed air test under water. The union has but three parts, a heavy ring of malleable iron, a bottom of malleable iron and a heavy thread end of high-grade brass. It is made in the octagon pattern, so that it may be applied with an ordinary monkey wrench; the regular round end pattern, the extra heavy pattern, designed for high pressures; and the hydraulic pattern, designed for very heavy pressures. The catalogue goes into details, with numerous illustrations, covering each type. Size 5¼x8 in. Pp. 72.

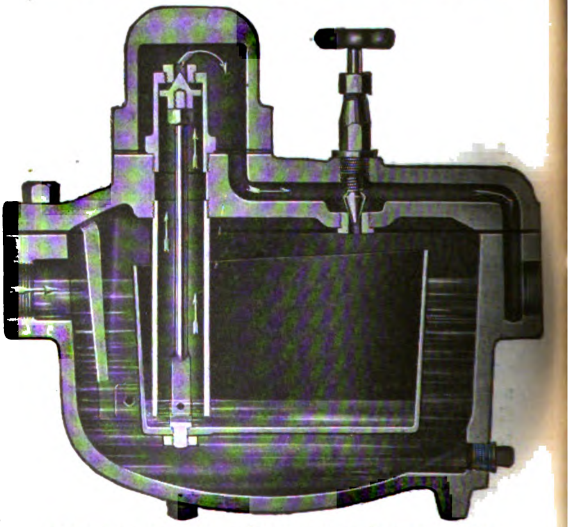


KEWANEE UNION, OCTAGON PATTERN.

Sturtevant Turbo-Undergrate Blowers, with which the steam output may be increased at a fraction of the cost of a new boiler, are brought to the attention of the trade in a new bulletin issued by the B. F. Sturtevant Co., Hyde Park, Mass. Among the advantages gained by using the Sturtevant turbo-undergrate blower are mentioned the attainment of 110 to 200% more horse-power without adding more boilers, the ability to burn cheaper fuel, such as screenings, culm or coke breeze; and greater furnace draft at any time to meet special calls or peak loads for power. These blowers are built in four sizes with 14-in., 18-in., 22-in. and 26-in. diameter fans. The bulletin contains a list of a number of firms which are using this apparatus. The bulletin is No. 1022.

Quincy Market Ammonia Compressor Safety Valve, a device approved by the Board of Boiler Rules, Commonwealth of Massachusetts, as complying fully with the provisions of the State law relating to ammonia compressors, is described in a bulletin issued by the Star Brass Mfg. Co., Boston, Mass., which also quotes the law in full on the subject. The circular also features the Quincy Market ammonia relief valve and the approved Quincy Market diffuser, for preventing the discharge of an undiluted column of ammonia gas into the atmosphere through a pipe other than a ventilating stack.

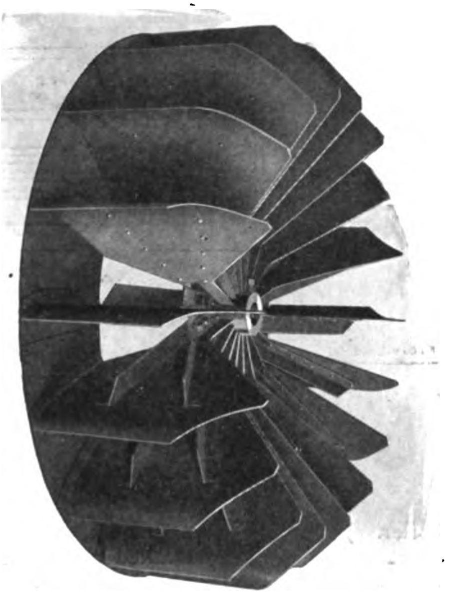
Kieley "Easy Repair" Steam Trap is featured in newly-issued circular matter published by the manufacturers, Kieley & Mueller, Inc., New York. The important advantage mentioned for this trap is that all the working parts, as well as the cover, can be removed without breaking any pipe connection due to the fact that all connections are in the body. The only parts liable to wear, it is stated, are the adjustable seat and the seat. By unscrewing two



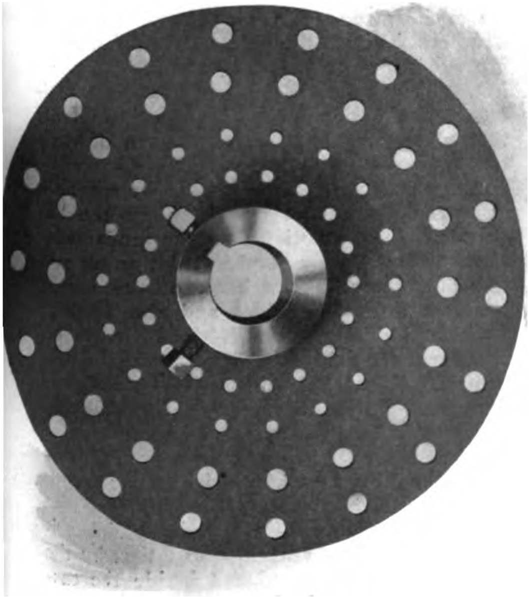
KIELEY "EASY REPAIR" STEAM TRAP.

nuts and removing the cap enclosing seat and disc, both are exposed and may be readily removed and renewed. One type of this trap is equipped with a water gauge. The company takes occasion to inform the trade and the public that "the genuine Kieley specialties are manufactured by ourselves and can only be secured through us or our branch houses or sales representatives."

Sweeping Improvement in Exhaust Fans is the title of a circular containing a reprint from the St. Louis *Lumberman* describing "an improved spider for blower fans," the reference being to the Bayley "B" planing mill exhaust fan, made by the Bayley Mfg. Co., Milwaukee, Wis. This type, it is shown, has a maximum of structural strength without metal overweighting, and, at the same time, the design permits of repairs with ease and convenience. In greater detail the features which distinguish the new blast wheel are that there is no cast-iron used in its construction; the arms are not cast into the hub; instead of a one-piece spider the wheel is of the built-up type; a central disc is used, a steel casting, machined all over, drilled for arms and carefully balanced; floats cut by template from No. 7 U. S. Gauge metal and of uniform weight; arms are two angles, hot riveted to central disc and spread at float end to support the inlet side of the float, thus shortening the overhang of the floats and strengthening them. The backs of the floats are supported by a back-shoot of heavy gauge metal. By this method each float is firmly riveted to its supporting arms. The blast wheel is of the multiblade type and its 18 blades are curved forward to accelerate the flow of air and increase the suction when running at a low peripheral speed.



BAYLEY "B" WHEEL COMPLETELY ASSEMBLED.



SHOWING A CENTRAL DISC OF BAYLEY WHEEL READY TO RECEIVE THE FLOATS

King Richon (K. R.) Hot Water Heating System, described as having all the advantages of low or high pressure or vacuum steam systems, as well as those of hot water systems, is the subject of a circular (Bulletin 41-A) published by the King Construction Co., North Tonawanda, N. Y. The striking feature of this system is that in a steam boiler carrying steam, the water from the boiler is circulated through the heating pipes instead of the steam. This inversion of the usual practice, it is stated, has solved many heating difficulties. The circulating water can be carried at any temperature from cold to 300° F. or more, thus covering the whole temperature range of ordinary hot water or low or high pressure steam systems. The water is circulated by a pump and in case of a breakdown a steam connection from the top of the boiler enables the system to be instantly changed to steam, the expansion of the water being taken care of by the steam space in the

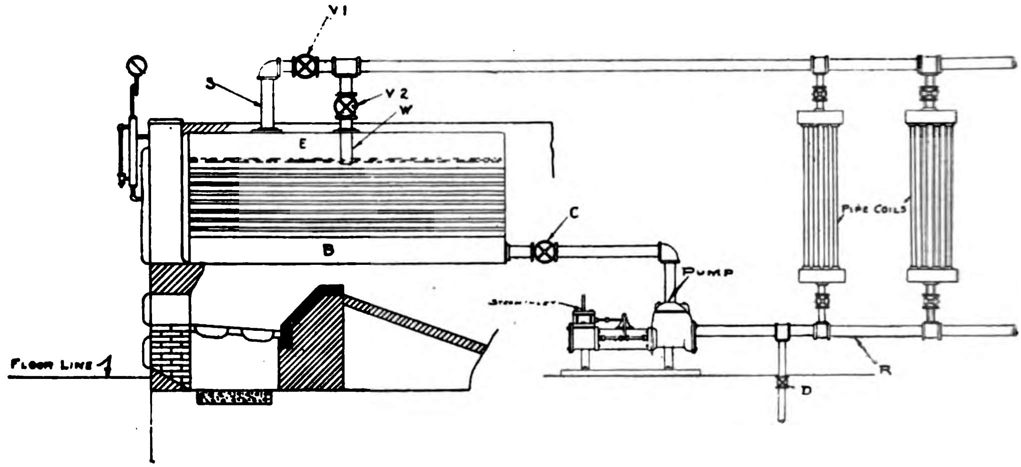


DIAGRAM OF THE KING RICHON HOT WATER HEATING SYSTEM.

boiler. With this arrangement, the same amount of piping is installed as would be used for steam. Also no expansion tank is required. The system, it is stated, is especially useful for greenhouse heating work. In the typical diagram shown herewith steam is taken through the opening S, while water is taken through the tube W. The return R from the heating system leads to the pump P, which discharges through the check valve C into the boiler. The return is also provided with a valve D, which can be opened to the atmosphere. In operating the system with water, the valve v1 on the steam opening is closed and the valve v2 opened. The system is filled with water except the space E, which cannot fill on account of the confined air. The pump P being started will draw water from the piping and force it into the boiler through the check valve C. This water will rise through the tube W into the main supply and thence through the system back to the pump. As the water in the system is raised in temperature, it will expand and partially fill space E. Ordinarily the volume of the space E is about four times the amount of the expansion of the water. Should anything happen to stop the pump, the system is instantly turned to steam by opening the valve v1 and closing v2, and opening the valve D in the return pipe R. The steam drives the water out of the system through valve D, which is afterwards partly closed, so as to allow only the water of condensation from the steam to pass out. This water, of course, can be returned directly to the boiler with a suitable pump or trap. A steam pump is generally used for circulating the water, the steam for driving the pump being furnished by a small auxiliary boiler. The exhaust steam from the pump is used for heating and with this design it is figured that the cost of pumping for a season, even on a large installation, is about the equivalent of three tons of coal.

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New Books.

The Ventilation Hand Book, by Charles L. Hubbard, is the title of a new book in the form of a series of questions, answers and descriptions, covering the principles and practices of ventilation as applied to warm air furnace heating; ducts, flues and dampers for gravity heating; and fans and fan work for ventilation and hot blast heating. The scope of the book includes toilets and chemical hoods, the design of air filters and washers and ventilation of various types of buildings.

The matter is well arranged in readable style and is written especially for the beginner. In connection with the fundamental requirements for good ventilation no evidence appears in the book of the recent thought on this subject and the familiar "standard of air purity," based simply on the carbonic acid proportion is again presented. Exception will be taken in some quarters to the statement of the effect of gas jets and lamps upon the ventilation of the room, recent investigations having indicated that there are beneficial effects due to the circulation of the air by the jets that may counterbalance many of the deleterious effects. The author states that by the use of a water pan placed inside the casing of a warm air furnace, the warm air passing over the pan "takes up a sufficient amount of moisture to give it the desired quality for proper ventilation." This is true, provided the water pan is placed at the proper point in the furnace, that is, above the dome, but with the usual form of construction, where it is located about on a level with the fire pot, it is well known, and perhaps the most serious handicap the warm air furnace is suffering from today, that the amount of moisture obtained will be far from sufficient.

The book has some 137 illustrations and has many valuable practical suggestions regarding installation details. The points raised by the questions are clearly answered, the drawings helping largely to make the explanations clear. Size 5½x8¼ in. Pp. 218. Published by the Sheet Metal Publication Co., New York, and may be had through the book department of the Heating and Ventilating Magazine Co. Price, $2.00 net.

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A Handy Hot Water Tank Calculator for the Asking.

Announcement is made by the Power Regulator Co., 5 South Wabash Avenue, Chicago, Ill., that copies of the celluloid hot water tank calculator, which was recently gotten up by this company, will be sent free to any of our readers who are actually engaged in the engineering, architectural or contracting business. As described in the February issue, the calculator may be used for figuring the amount of coil surface in iron pipe and in brass pipe, as well as the pounds of condensation per hour. The calculator is in the form of two discs, one superimposed on the other. By moving the upper disc until the various quantities register, the result may be read directly from the calculator.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from The Heating and Ventilating Magazine *on receipt of the stated price.*

CHURCHES—

The Heating and Ventilating of Churches. Harold L. Alt. Ills. 3500 w. Bkbld—Dec., 1915. Practical systems and their installation. 60c.

VENTILATION—

Ozone for Ventilation. Ills. 2500 w. M & C E—Dec. 15, 1915. Report of test of Westinghouse air ozonizer, with experiments by Sheppard T. Powell. 20c.

THE BUSINESS OUTLOOK.

IV.

By Frank M. Huston,

Financial Editor of the Chicago Evening Post; Editor Rand-McNally Bankers' Monthly.

General business is responding to the strong financial conditions in this country in a way that is reassuring. Bank clearings, since the beginning of the year have established a new high record, while business defaults for the first month of the year show a decrease in number of 25% compared with a year ago and in liabilities, which aggregate only about one-third what they were in 1915. All indications favor a further improvement in the business situation, a decline in commercial mortality and a lessened volume of liabilities.

Furthermore, there has been an increase in bank deposits all over the country that bespeaks a further expansion of business, and an increase in the credit available as a purchasing power. The effect of the enormous influx of gold, together with the exceedingy profitable business which Europe is doing with this country is being reflected in all lines of trade. Whereas a few months ago our prosperity was rather spotted, today it is broadening out and becoming more general.

The chief danger in the situation, however, is that our expansion in business may result in an inflation that ultimately must be followed by a reaction and depression. It is for this reason that bankers are admonishing business men generally to proceed with less insistence in expanding their business and to get back on a more normal basis so far as their borrowings are concerned. In other words, bankers and those who study business conditions closely are desirous that business men keep their affairs in as liquid a condition as it is possible to do and in this way they will be able to sustain prosperity through the period of readjustment that inevitably must follow the war.

From all sections of the country come advices of a heavy distributing of merchandise of various kinds, reflecting the increased demand, resulting from expanding purchasing power of the country at large. Retail dealers, mail order houses, as well as jobbers of various kinds, are active in making purchases for immediate requirements and for future delivery. Collections are exceedingly good, which is a further reflection of an improved business condition.

Among the railroads there is an evidence of prosperity that has not been experienced in many years. There is no industry in this country that is as basic in its character, with the possible exception of steel making, as is the transportation business. Railroad earnings are showing monthly increases over a year ago both in gross and net, which is a healthy condition.

Capital in this country is accumulating exceedingly rapidly and naturally with this accumulation there is a corresponding increase in the demand for labor and for the products of labor.

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Expansion of Pipe Coils and Length of Spring Pieces.

The elongation of steam or hot water pipe coils and the length of their spring pieces is given in the following table. Coils over 200 ft. in length should have, if possible, a spring piece at each end, with an anchor in the center. The difference in tmperature ranges for steam coils from 52° to 232° F. For hot water coils the range is from 50° to 200° F.

EXPANSION OF COILS AND LENGTH OF SPRING PIECES.

Length of coil. Feet.	Elongation steam differ. in temp. 52°-232°F. Inches.	Length of shortest piece of spring piece. Ft. & in.	Elongation water differ. in temp. 50°-200°F. Inches.	Length of shortest piece of spring piece. Ft. & in.
10	9-64	1.6	⅛	1.6
20	9-32	1.6	¼	1.6
30	7-16	2.0	⅜	2.0
40	9-16	2.0	½	2.0
50	¾	3.0	⅝	2.0
60	⅞	3.0	¾	3.0
70	1	4.0	⅞	3.0
80	1 3-16	4.0	1	4.0
100	1½	5.0	1 3-16	4.0
120	1¾	6.0	1½	5.0
140	2	7.0	1¾	6.0
	2⅜	8.0	2	7.0
180	2¾	9.0	2 3-16	8.0
200	3	10.0	2⅜	8.0
240	3½	12.0	2⅞	10.0
260	3 9-16	13.0	3⅛	11.0
280	4	14.0	3 5-16	12.0
300	4 5-16	15.0	3 9-16	12.0
320	4-9-16	16.0	3¾	13.0
340	4 13-16	17.0	4	14.0
360	5¼	18.0	4 5-16	15.0
380	5½	19.0	4½	16.0
400	6	20.0	4 13-16	16.0

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK APRIL, 1916

Determination of Radiator Sizes for Hot Water Heating Plants

WITH CHARTS FOR SIMPLIFYING CALCULATIONS.

BY FREYWID WEGELIUS.

NOTE.—Regarding the different heat emitting capacity of steam and hot water radiators, the writer's opinion on this question is supported by the very careful experiments made at the testing station for heating and ventilating apparatus at Charlottenburg, Germany, and which also accord fully with the results obtained from several other experiments. This phenomenon may be explained as follows: When water is flowing through a radiator, only a small portion of its particles are striking the inner surfaces of the radiator, and the greater number of particles are thus running through the radiator without touching the surfaces. When steam is flowing through the radiator there is, due to the mobility and condensation of the steam, a continuous current of steam particles flowing towards the inner sides of the radiator, causing an intimate contact between the steam particles and the radiator surface. Thus the heat from the whole steam mass is directly emitted through the radiator surfaces, differing in that respect from hot water heating, where only a part of the heat is directly emitted.

The general expressions of M (B.T.U. transmitted by the total radiator surface per hour), as shown in a previous article on this subject (see THE HEATING AND VENTILATING MAGAZINE for January, 1916) and here reproduced, enable the engineer to obtain the amount of heat emitted by a 1-, 2-, 3-, or 4-col. radiator of a known size and for all temperature differences. As in Europe radiators of the Ideal type (made by the American Radiator Company) are very commonly used, the accompanying charts, I, II., III., and IV., are based upon this type of radiator.

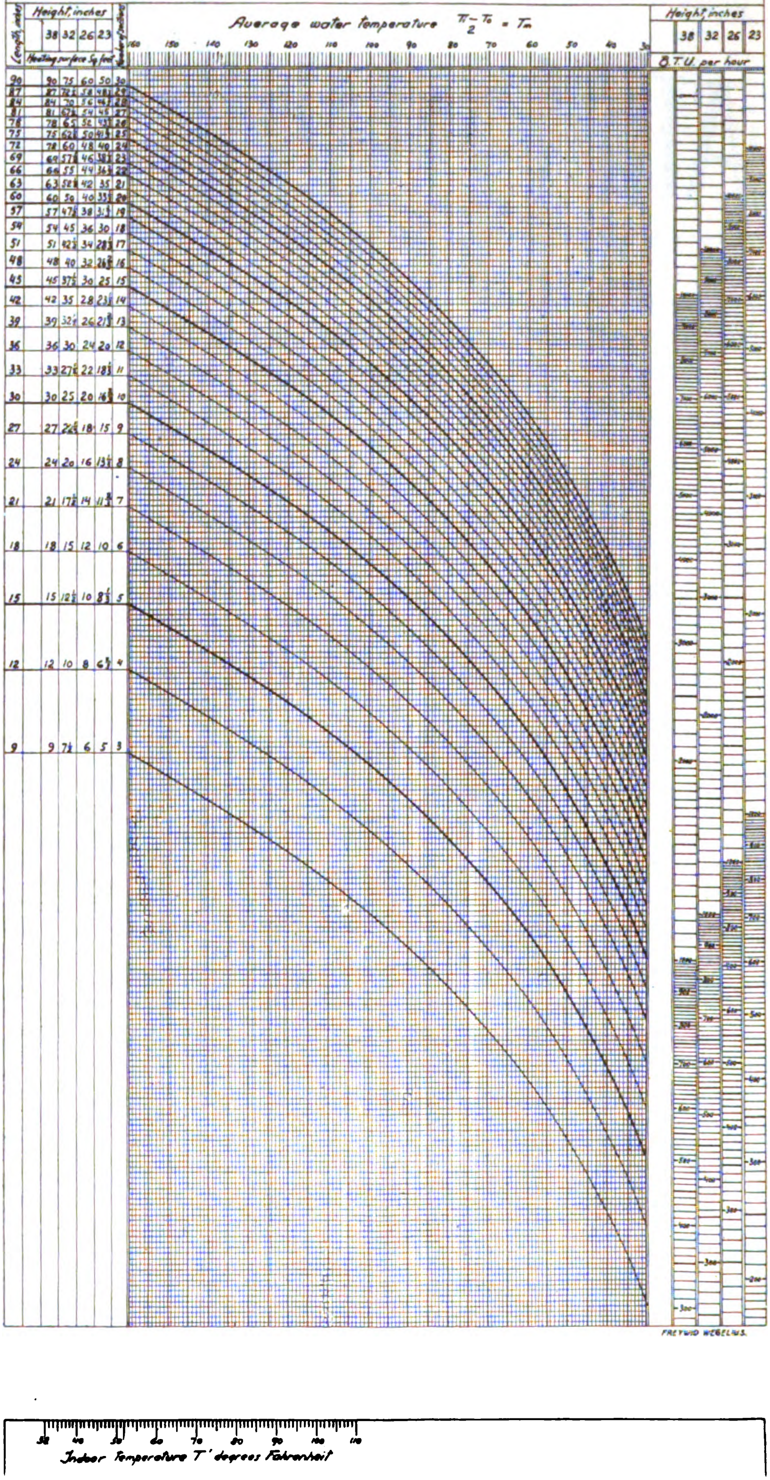
First let us consider Chart II. for 2-col. radiators which are those mostly used. We may put the average water temperature as

$$T_m = \frac{T_1 - T_0}{2}$$

GENERAL EXPRESSION OF

	K	R	M
1 and 2 column radiators	$1.043 \frac{T_d^{0.151}}{h^{0.13}}$	$\frac{1}{1.043} \frac{h^{0.13} M}{T_d^{1.151}}$	$1.043 \frac{T_d^{1.151} R}{h^{0.13}}$
3 column radiators	$0.944 \frac{T_d^{0.151}}{h^{0.13}}$	$\frac{1}{0.944} \frac{h^{0.13} M}{T_d^{1.151}}$	$0.944 \frac{T_d^{1.151} R}{h^{0.13}}$
4 column radiators	$0.882 \frac{T_d^{0.151}}{h^{0.13}}$	$\frac{1}{0.882} \frac{h^{0.13} M}{T_d^{1.151}}$	$0.882 \frac{T_d^{1.151} R}{h^{0.13}}$

Chart 1. Graphic chart for determining sizes of the American Radiator Company's „Ideal" 1 column radiators.



(Copies of charts 1-4, 11½ x 23 in., will be sent postpaid to any address on receipt of 25 cents.)

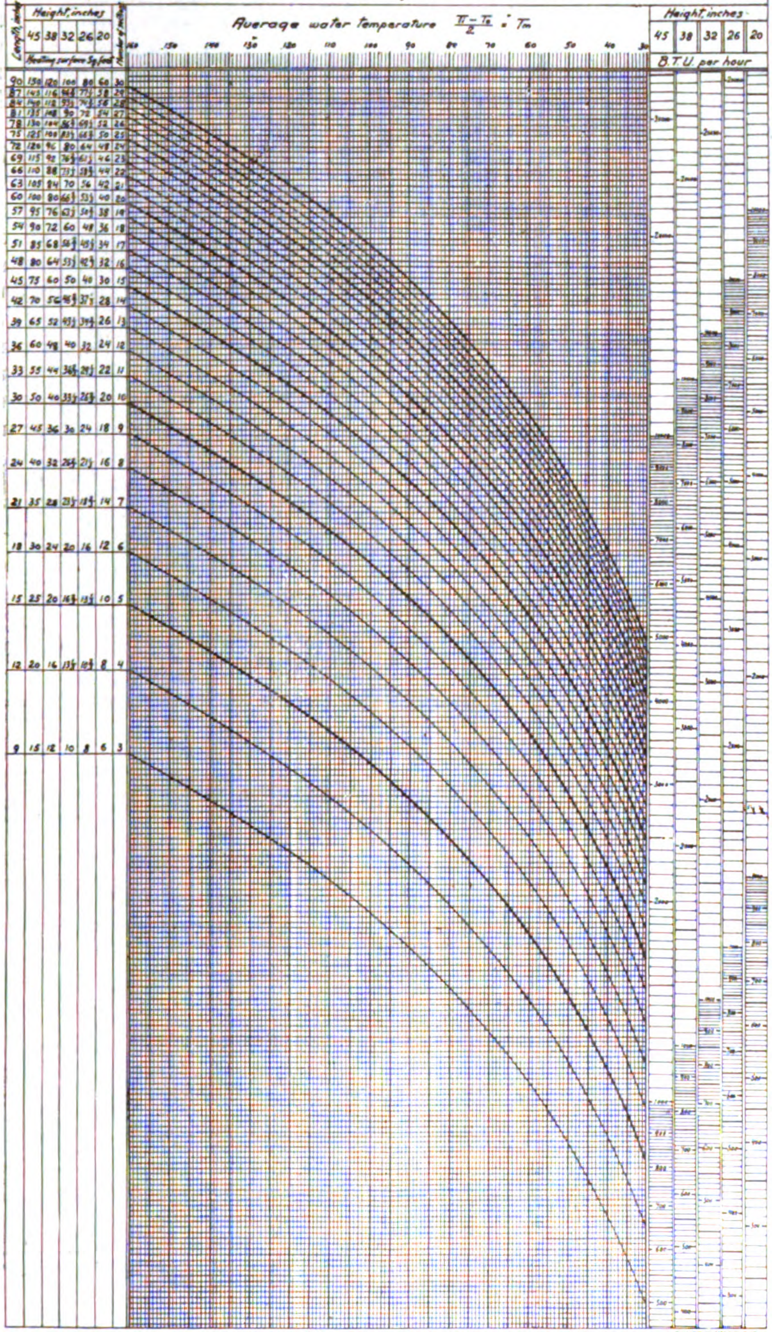
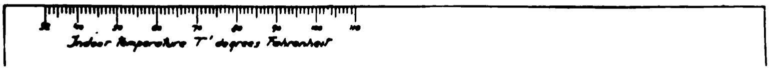


Chart 2. Graphic chart for determining sizes of the American Radiator Company's „Ideal" 2 column radiators.



(Copies of charts 1-4, 11½ x 23 in., will be sent postpaid to any address on receipt of 25 cents.)

T_i being inlet, and T_0 outlet water temperatures. Each curve on the chart represents five different radiators, of the same length and number of sections, but of different heights and surfaces. On the right side of the chart there are five scales corresponding to the B.T.U. emitted by the different heights. On the left there are seven columns, five of which indicate the surface corresponding to the different heights, and two the length and number of sections.

As one is not likely to figure on indoor temperatures below 32° F., the charts have been based on this indoor temperature. For any indoor temperature above 32° it is necessary to use a temperature rule the scale of which is drawn on the lower margin of the chart.

The only calculation to be made before using the chart is to subtract the number 32 from the average water temperature T_m. Let us call this difference $T_{d32} = (T_m - 32)$

If, for instance, the average water temperature in a heating plant be 180° F., then $T_{d32} = 180 - 32 = 148$. A 45-in. high radiator, we will say, is required, with a heat emitting capacity of 3,000 B.T.U. per hour. To determine the needed surface, number of sections and length of radiator, place the temperature rule horizontally on the chart at a height corresponding to 3,000 B.T.U. on the 45-in. scale and with the number 32 of the temperature rule on the vertical 148-line, also called the T_{d32} line. Now, if the indoor temperature is 32° F., follow the curve that is nearest to the intersecting point between the vertical 148-line and the temperature rule. This will give the number of sections which equal 3, and in the 45-in. column the surface is found to be 15 sq. ft., and in the furthest column the length equals 9 in.

If the indoor temperature is above 32°, as is generally the case, and if the other conditions are unchanged, the temperature-rule is held exactly in the same place, and the curve that is nearest to the indoor temperature in question on the temperature rule say, 66°, is followed to the columns on the left side, where the number of sections, surface and length of radiator are directly read. In this way, in the case mentioned, one

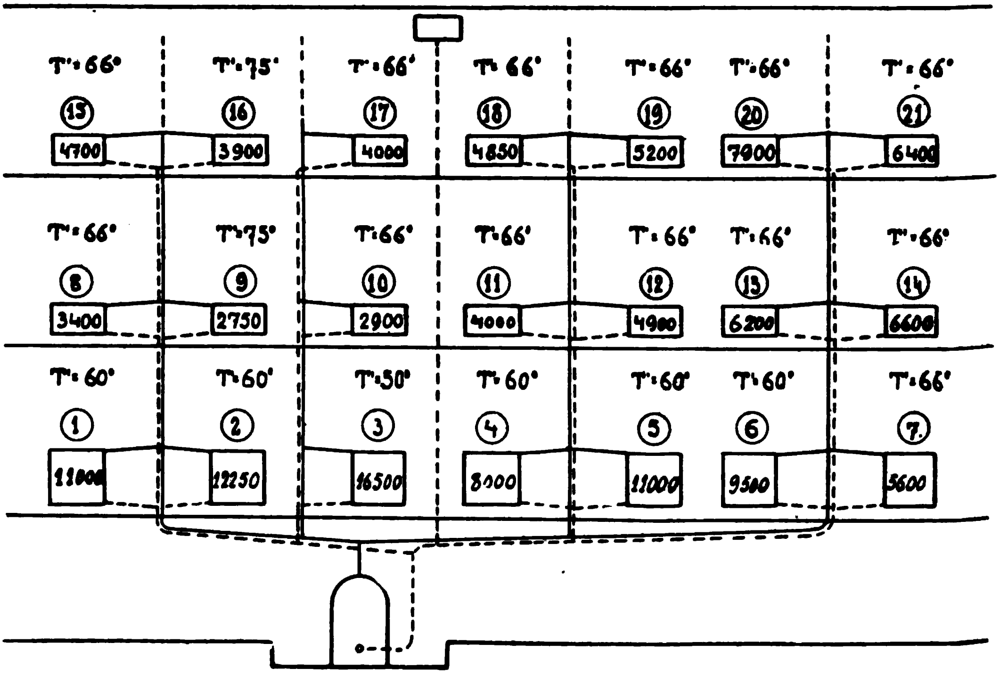


FIG. 6.—HOT WATER HEATING PLANT, TWO-PIPE SYSTEM, REFERRED TO IN EXAMPLE 1.

gets for an indoor temperature of 66°, four sections 45-in. high, 2-col., 20 sq. ft. and 12 in. length of radiator. An indoor temperature of 85° would require five sections of the same type, with 25 sq. ft. of surface and 15 in. length, and so on.

If for another hot water heating plant, the conditions are changed as follows: Average water temperature 125° F., type of required radiator, 2-col. 26-in. high; and its heat emitting capacity 5,500 B.T.U. per hour, in that case T_{d32} becomes 125 — 32 = 93, and for an indoor temperature of 55°, the required radiator will be: Number of sections, 22; surface, 58 2/3 sq ft.; length, 66 in. An indoor temperature of 62° would give 25 sections, 66 2/3 sq. ft. and 75-in. length, and so on. The other charts are used in a similar manner.

To simplify the matter the writer generally uses table-forms as employed for the examples below.

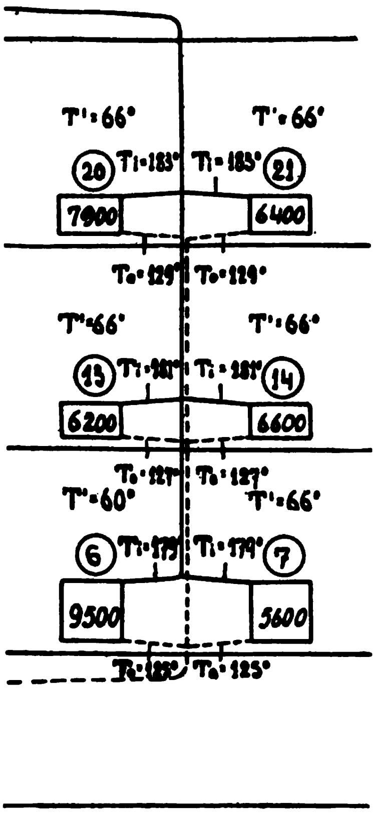
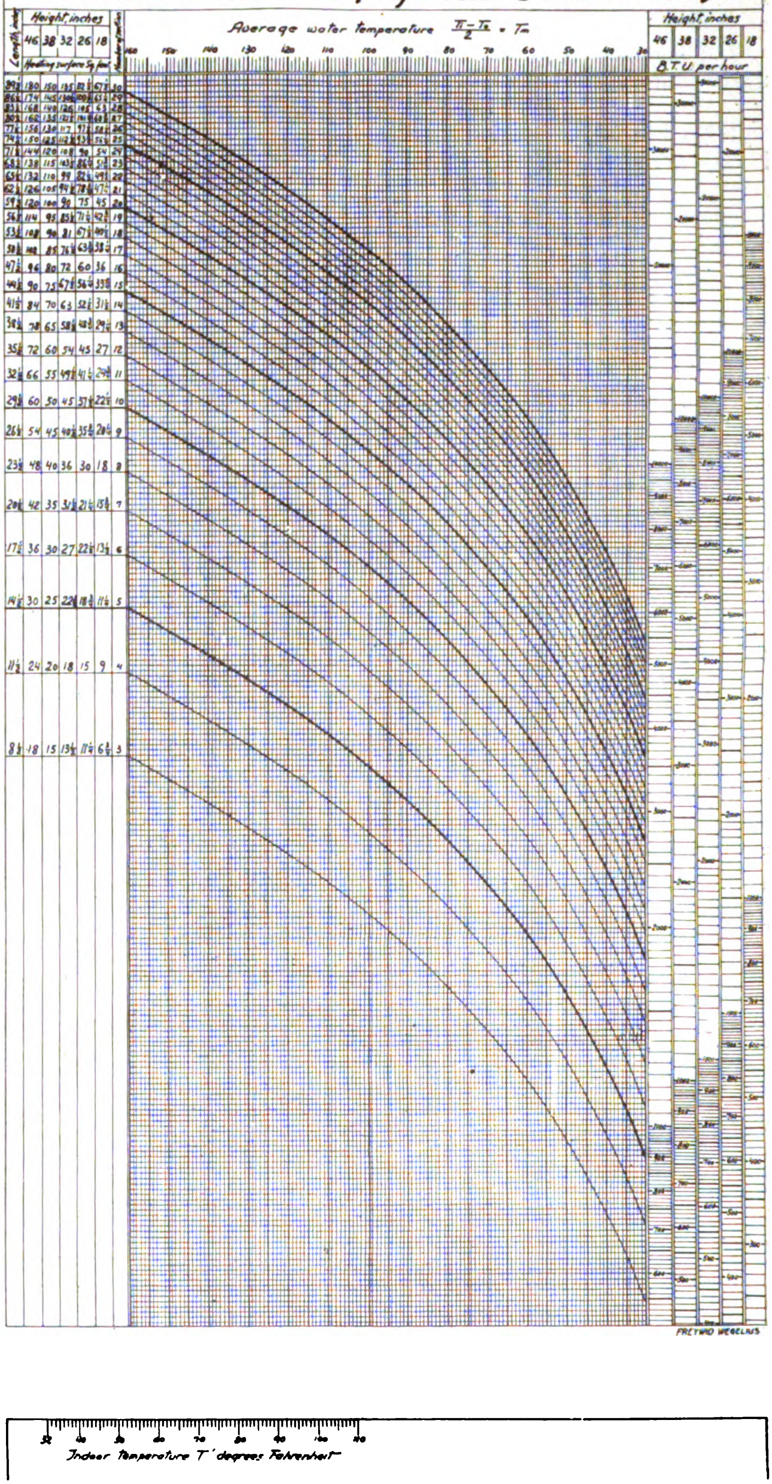


FIG. 7.—TWO-PIPE SYSTEM REFERRED TO IN EXAMPLE 2.

Example 1. Hot water heating plant, two-pipe system, without regarding cooling effect by the pipes. Average water temperature $= \frac{190 + 140}{2} = 165$; $T_{d32} = 165 - 32 = 133$. For the sake of space no plan drawings are used, but only elevations. On the first floor there are to

Room No.	T_{d32}.	Indoor temp. T'.	Heat emitting capacity M.	Heating surface, sq. in. 45-in.	38-in.	32-in.	26-in.	20-in.	Radiator sections and heights.
First Floor—									
1	133	60	11,000	80	..	..	..	..	16/45 (II)
2	133	60	12,250	90	..	..	..	..	18/45 (II)
3	133	50	16,500	110	..	..	..	..	22/45 (II)
4	133	60	8,000	60	..	..	..	..	12/45 (II)
5	133	60	11,000	80	..	..	..	..	16/45 (II)
6	133	60	9,500	70	..	..	..	..	14/45 (II)
7	133	66	5,600	45	..	..	..	..	9/45 (II)
Second Floor—									
8	133	66	3,400	..	..	..	24	..	9/26 (II)
9	133	75	2,750	..	..	..	21⅓	..	8/26 (II)
10	133	66	2,900	..	..	..	21⅓	..	8/26 (II)
11	133	66	4,000	..	..	..	29⅓	..	11/26 (II)
12	133	66	4,900	..	..	..	34⅔	..	13/26 (II)
13	133	66	6,200	..	..	..	48¾	..	13/26 (III)
14	133	66	6,600	..	..	..	52½	..	14/26 (III)
Third Floor—									
15	133	66	4,750	..	..	..	34⅔	..	13/26 (II)
16	133	75	3,900	..	..	..	32	..	12/26 (II)
17	133	66	4,000	..	..	..	29⅓	..	11/26 (II)
18	133	66	4,850	..	..	..	34⅔	..	13/26 (II)
19	133	66	5,200	..	..	..	37⅓	..	14/26 (II)
20	133	66	7,900	..	..	..	65	..	13/26 (IV)
21	133	66	6,400	..	..	..	52½	..	14/26 (III)

Chart 3. Graphic chart for determining sizes of the American Radiator Company's "Ideal" 3 column radiators.



(Copies of charts 1-4, 11½ x 23 in., will be sent postpaid to any address on receipt of 25 cents.)

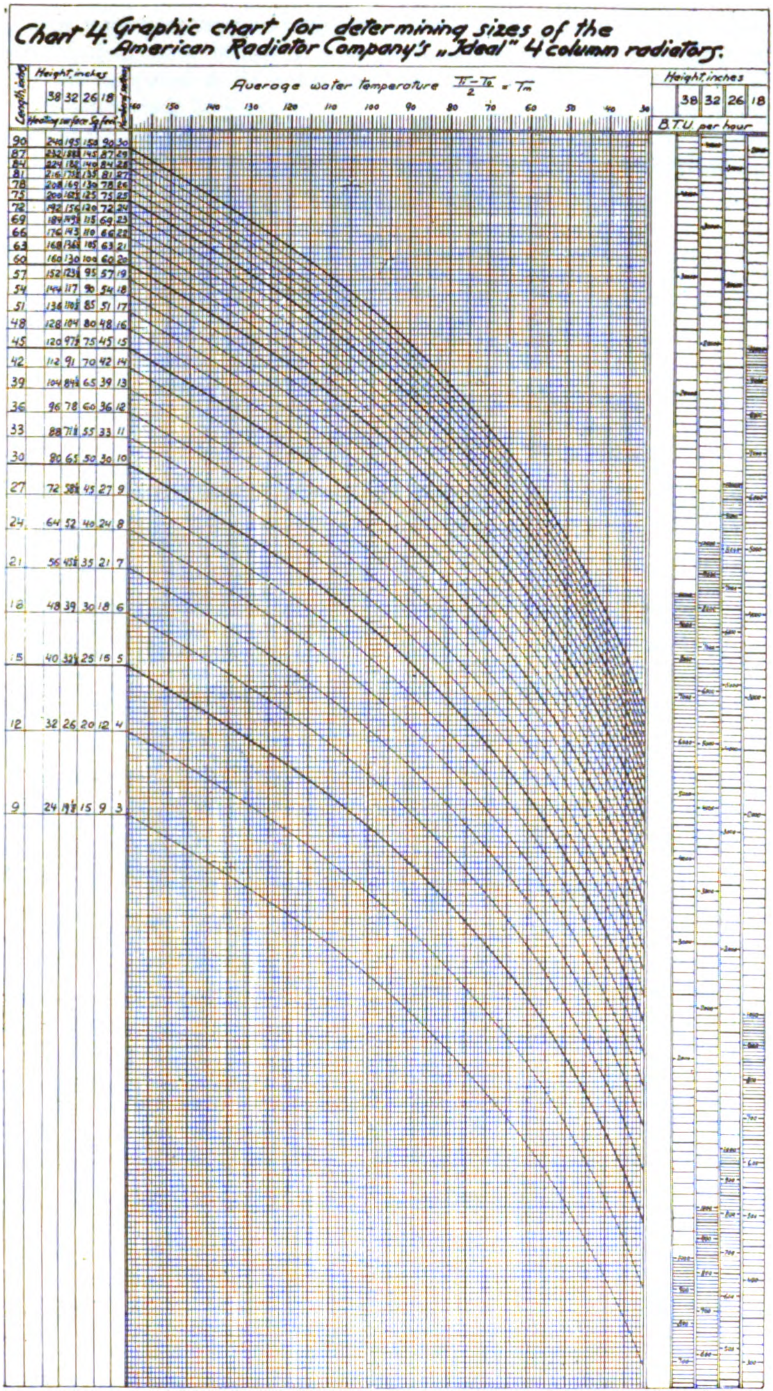
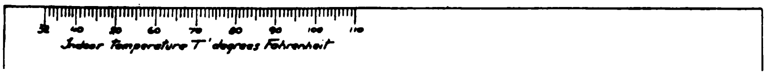


Chart 4. Graphic chart for determining sizes of the American Radiator Company's „Ideal" 4 column radiators.

Length, inches	Height, inches Heating surface Sq. feet 38	32	26	18	Number of sections
90	240	195	150	90	30
87	232	188½	145	87	29
84	224	182	140	84	28
81	216	175½	135	81	27
78	208	169	130	78	26
75	200	162½	125	75	25
72	192	156	120	72	24
69	184	149½	115	69	23
66	176	143	110	66	22
63	168	136½	105	63	21
60	160	130	100	60	20
57	152	123½	95	57	19
54	144	117	90	54	18
51	136	110½	85	51	17
48	128	104	80	48	16
45	120	97½	75	45	15
42	112	91	70	42	14
39	104	84½	65	39	13
36	96	78	60	36	12
33	88	71½	55	33	11
30	80	65	50	30	10
27	72	58½	45	27	9
24	64	52	40	24	8
21	56	45½	35	21	7
18	48	39	30	18	6
15	40	32½	25	15	5
12	32	26	20	12	4
9	24	19½	15	9	3



(Copies of charts 1-4, 11½ x 23 in., will be sent postpaid to any address on receipt of 25 cents.)

be used 45-in. high radiators, on the second and third floor 26-in. high radiators.

Example 2. Two-pipe system, cooling effect of pipes regarded. Hot water inlet and outlet temperatures for each radiator taken out from Fig. 7.

Room No.	T_{das}.	Indoor temp. T′.	Heat emitting capacity M.	Heating surface, sq. in. 45-in.	38-in.	32-in.	26-in.	20-in.	Radiator sections and heights.
7	120	66	5,600	55	..	..	..	..	11/45 (II)
14	122	66	6,600	..	..	..	53⅓	..	20/26 (II)
21	124	66	5,400	..	..	..	50⅔	..	19/26 (II)

Example 3. One-pipe system, without regarding cooling effect of pipes. Water temperatures according to Fig. 8 (see table below).

For a convenient use of the charts, the writer has had the indoor temperature scale marked on a wooden rule of the form shown below.

It is a simple matter to draw similar charts for any type of radiator. As a matter of fact, the writer is drawing charts of the same kind for steam radiators.

In the writer's preceding article in the January issue, there was mentioned the general equation for the heating emitting capacity of radiators. This equation

$$K = \alpha \frac{T_d^{\,tg\,\varphi}}{h^{\,tg\,\psi}}$$

has been deduced by the writer chiefly from tests made by Rietschel with hot water radiators. It has led to the supposition that the heat transmission through walls, ceilings, windows, etc., might be expressed by a similar equation which would also include the thickness of the wall, velocity of air etc. In fact, several tests of that transmission through building materials, made with electric radiators by G. Andersson, G. Huber, A.

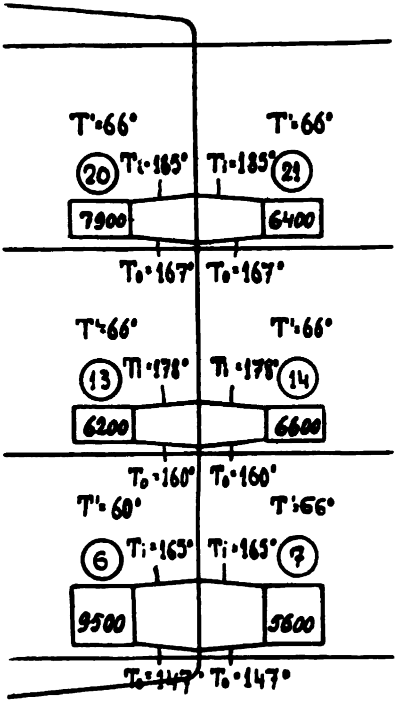


FIG. 8.—ONE-PIPE SYSTEM REFERRED TO IN EXAMPLE 3.

Room No.	T_{das}.	Indoor temp. T′.	Heat emitting capacity M.	Heating surface, sq. in. 45-in.	38-in.	32-in.	26-in.	20-in.	Radiator sections and heights.
7	124	66	5,600	50	..	..	..	..	10/26 (II)
14	137	66	6,600	..	..	..	45⅓	..	17/26 (II)
21	144	66	6,400	..	..	..	40	..	15/26 (II)

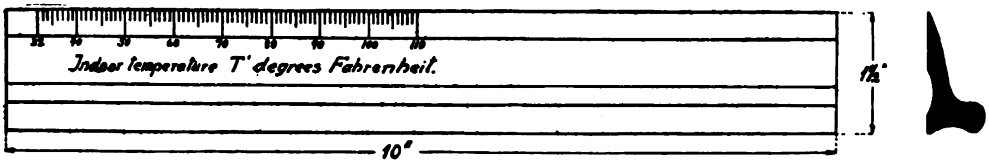


FIG. 9.—DESIGN OF WOODEN SCALE, MARKED WITH INDOOR TEMPERATURES.

Alftan and the writer at our laboratory in Helsingfors, Finland, show a good conformity to this equation, at least for a constant thickness and low air velocities. If this conformity is confirmed for greater ranges and grows into a new general law, which we hope to be able to demonstrate before long, one would be obliged later on to reckon with a changeable heat transmission factor, the value of which would also depend on the height of the transmitting surface.

Pipe Hangers

METHODS OF ARRANGING AND DETERMINING STRENGTH OF VARIOUS TYPES OF SUPPORTS

By HAROLD L. ALT.

II.

If it is thought desirable to suspend the riser from the top, we have the set of hangers as shown in Fig. 11. Here hanger No. 7 carries the entire load of the riser and horizontal ceiling run, half way to hanger No. 6 Hangers Nos. 5 and 6 are the same as before shown in Fig. 8 and hanger No. 8 is a guide similar to the one shown in Fig. 10. To design hanger No. 7 (Fig. 12) we first obtain the load which, if we assume this as steam pipe, will consist of about 5 ft. of 8-in. W. I. pipe on first floor ceiling, one 8-in. C. I. flanged ell L. P., about 25 ft. of 8-in. W. I. pipe in riser, one 8-in. C. I. flanged ell at base and, say, another 5 ft. of pipe running half way to the next hanger. This totals 35 ft. of pipe at 28 lbs. per foot and

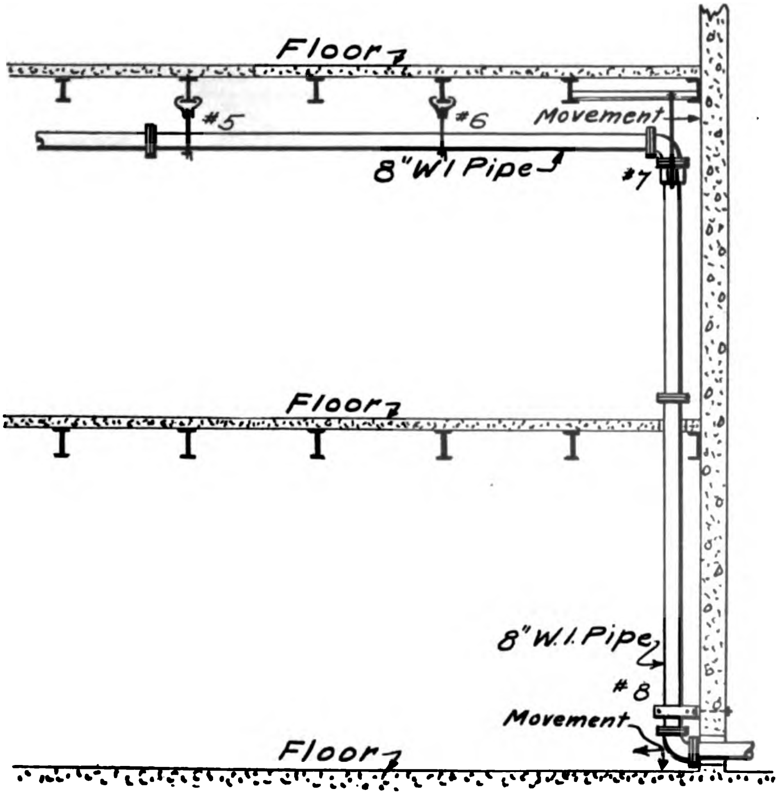


FIG. 11.—ARRANGEMENT OF HANGERS FOR SUSPENDING RISER FROM TOP.

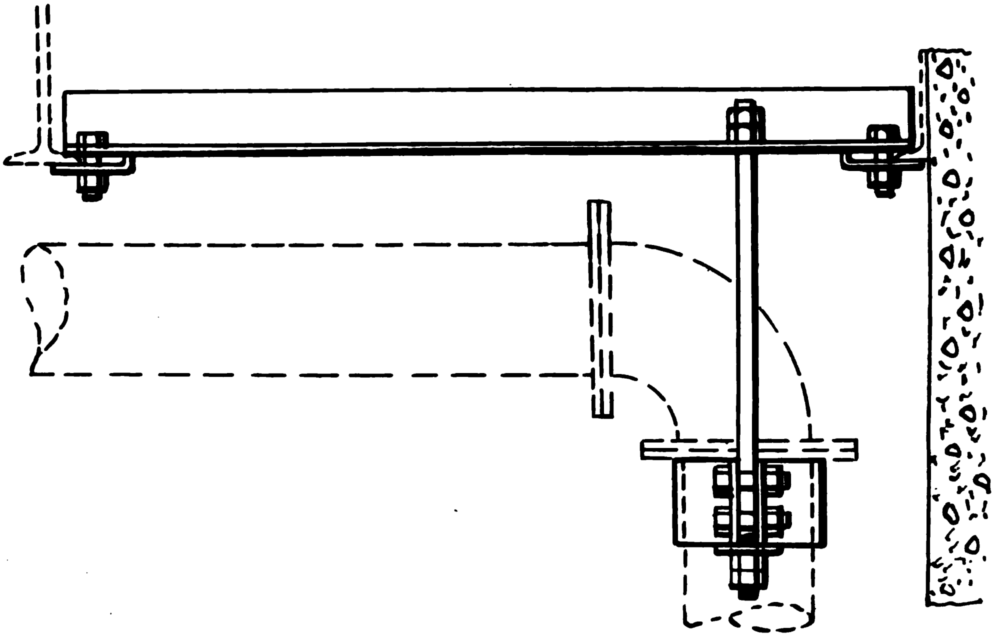


FIG. 12.—DETAIL OF HANGER NO. 7 (FIG. 11).

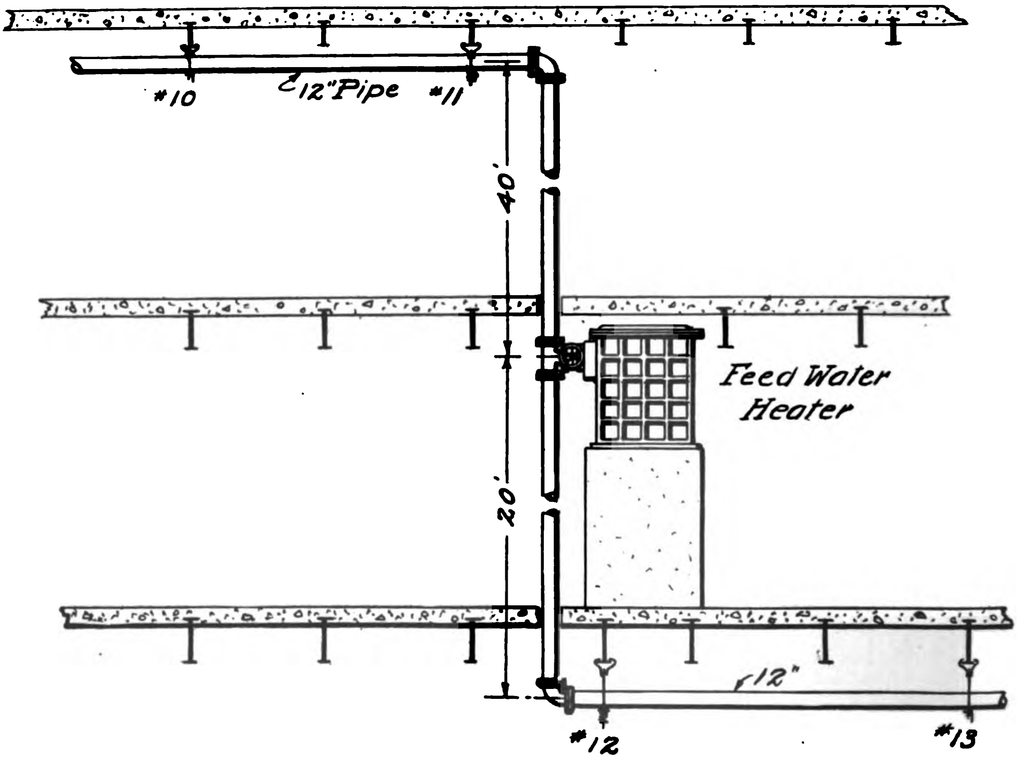


FIG. 13.—ARRANGEMENT OF HANGERS TO PROVIDE FOR VARYING CONDITIONS.

2 ells at 120 lbs. each, or a total load of 1,220 lbs. As this is steam pipe it might at some time become filled with condensation water so we will add 22 lbs. x 35 lineal feet or 775 lbs. for this contingency. This gives a total possible load of 1,220 plus 775 or 1,995, say, 2,000 lbs. Then each rod going down to the clamp will carry only 1,000 lbs. which, with stress of 8,000 lbs. per square inch, requires a cross-section area of 1,000 divided by 8,000 or ⅛ sq. in. The point where the rod is supported by the angle is so near one side that loading amounts to but little more in effect than if it were equally distributed. If the rod is 12 ins. from end of angle and the angle is 60 ins. long, the bending moment is equal to the beam load at either end times the distance between rod and beam in inches. The beam load is inversely proportional to the same distance. As the rod is one-fifth the distance of the total span away from channel, the I beam will carry one-fifth of hanger load and since the rod is four-fifths of the distance of the total span away from I beam, channel will carry four-fifths of load. The bending moment is then one-fifth of 1,000 lbs. x four-fifths of 60 or four-fiths of 1,000 lbs. times one-fifth of 60, according to which end you take and the result is the same, *viz.*, 9,600 divided by 12,000 = about 0.75 sectional modulus, required, or 3 in. x 3-in. x ⅜ in. angle, which has a sectional modulus of 0.83.

WHEN HANGERS MUST ADJUST THEMSELVES TO VARYING CONDITIONS.

There are some cases which may be encountered where pipe hangers must adjust themselves to varying conditions caused by expansion and there are any number of installations where such requirements can only be met by hangers of this type. To show this in simple form, let us take Fig. 13 in which low pressure steam pipe is carried through below one floor, then passes up through the floor, making a connection through a valve to a feed water heater and continues on up to second floor above where it runs horizontally over to a free exhaust outlet. If we assume that hangers have been decided upon at locations marked Nos. 10, 11, 12 and 13, hangers Nos. 10 and 13 may be dismissed from our consideration, as they are of the familiar clamp type, and we may devote ourselves to requirements of hangers Nos. 11 and 12. From tables of weights of fittings given in any fitting catalog we can compute the weight of pipe on hanger No. 11, assuming that this hanger carries half the weight from No. 10 down as far as the connection to the feed water heater. Starting with the pipe midway between hangers Nos. 10 and 11 and going toward feed water heater, we have approximately:

7 ft. of 12-in. standard weight pipe or 49 lbs. x 7 or	343 lbs.
1 ft. of 12-in. standard weight ell or 260 lbs. x 1 or	260 lbs.
38 ft. of 12-in. standard weight pipe or 49 lbs. x 38 or	1,862 lbs.
½ ft. of 12-in. standard weight tee or 390 lbs. x ½ or	180 lbs.
½ ft. of 12-in. standard weight valve or 1,200 lbs. x ½ or	600 lbs.
or a total of	3,245 lbs.

For hanger No. 12 we may assume that the piping from the heater connection down to half way between hangers Nos. 12 and 13 is carried by this support which makes the load as follows:

½ ft. of 12-in. standard weight tee or 390 lbs. x ½ or	180 lbs.
½ ft. of 12-in. standard weight valve or 1,200 lbs. x ½ or	600 lbs.
18 ft. of 12-in. standard weight pipe or 49 lbs. x 18 or	882 lbs.
1 ft. of 12-in. standard weight ell or 260 lbs. x 1 or	260 lbs.
9 ft. of 12-in. standard weight pipe, or 49 lbs. x 9 or	441 lbs.
or total of	2,363 lbs.

Now supposing this pipe is erected and carefully adjusted at hangers Nos. 11 and 12 so that practically no weight is brought on the valve connection at the heater. This means that hanger No. 11 will be tightened up until it carries approximately 3,245 lbs. and that hanger No. 12 will be adjusted until it carries about 2,363 lbs.

So far so good. But what happens when steam is turned into the pipe? Immediately the pipe expands and raises from its fixed point (which is at the heater connection) so as to take the load entirely off hanger No. 11 and to throw it onto the connection to the heater. This is almost sure to produce a leaky joint at this point, and in the meantime the pipe from the lower horizontal main to the heater has also expanded, which farther assists in leakage. If other conditions are equal, this pipe, which is 20 ft. long, will expand one-half as much as the upper section, which is 40 ft. long, since it is only one-half the length. This expansion immediately results in a strong upward thrust on the heater connection and an equal downward thrust plus the weight of the pipe on the hanger No. 12.

Now what happens when this expansion takes place—for it is bound to take place! Either the heater must be lifted or the hanger No. 12 must deflect sufficiently to accommodate the expansion.

PIPE EXPANSION TABLE.

Let us see just how much this expansion will be. By reference to the table shown in Fig. 14, a great deal of tiresome computation can be avoided as this table shows at a glance the expansion in inches per 100 ft. for both wrought-iron and cast-iron pipe, either covered or uncovered. In this table the number of degrees rise in temperature is given across the top and the expansion for 100 ft. of pipe is given in the extreme left-hand column.

Assuming that this is low pressure steam pipe, we have an interior temperature which will be in the neighborhood of 220° F. and since piping in most modern installations is covered we would use the diagonal line marked "Covered Wrought Iron Pipe." If the room is at 70° F. normal temperature, the increase in temperature when the pipe is heated amounts to 220°-70°, or about 150°. Placing a pencil on the vertical line marked 150° and running down this line to the diagonals, the first diagonal we strike is that for "Covered Wrought-Iron Pipe" (which is the one to use in this case) and we find that covered wrought-iron pipe intersects with the 150° line at the horizontal line marked "1¼ in." which shows that 100 ft. of pipe under these conditions will expand 1¼ in. Since we have only 40 ft. above the heater, we have 40/100 of this amount or ½ in. and with 20 ft. below the heater we will, of course, have just half as much, or ¼-in.

These figures are small and yet a change of ½-in. or even ¼-in. in the length of these vertical risers is sufficient to transfer practically all of the load (which was previously adjusted so as to be carried by hangers) onto the heater connection and will invariably produce leaks at this point.

SPRING HANGERS.

The only way to overcome the difficulty satisfactorily is by use of spring

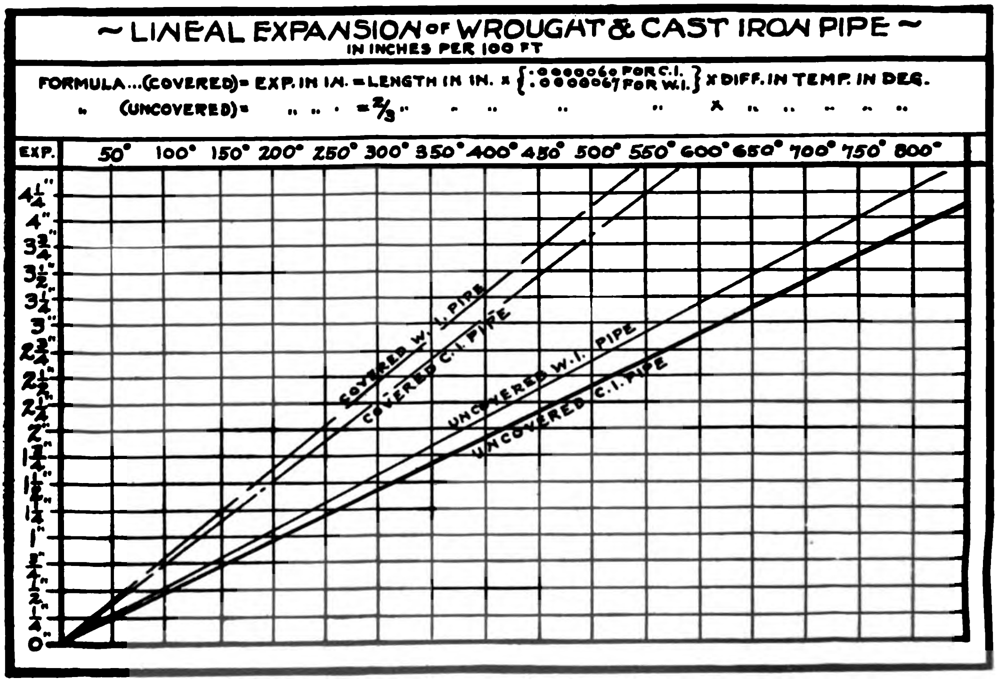


FIG. 14.—PIPE EXPANSION CHART.

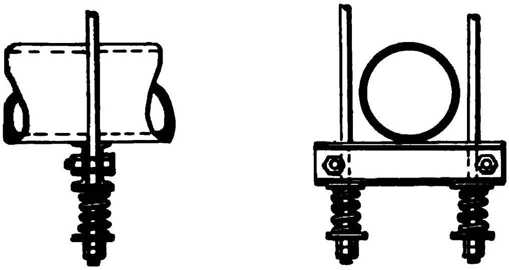


FIG. 15.—SPRING HANGERS.

hangers which may be somewhat of the type shown in Fig. 15 where two rods are carried through between 4-in. channels placed back to back and have springs located between the channels and nuts on the bottom of the rod. If there is room above the pipe sufficient to allow the use of the hanger shown in Fig. 16, it will be just as satisfactory and is cheaper than using two rods. In this design it is well to use a separator plate on the top of the channel to keep the middle rod in proper position, this plate having three holes, two being for the U-bolt and one being for the hanger rod. A still cheaper form of hanger, requiring only one spring, is shown in Fig. 17, but it must be remembered that a single spring will have to carry twice the load supported on the other two.

Springs can be designed in a general way from the tables and rules given in Kent's "Mechanical Engineer's Handbook," but they should always be ordered from the manufacturer with the guarantee to deflect a given amount with a given increase in the load, as temper and other characteristics vary in stock used by different spring makers.

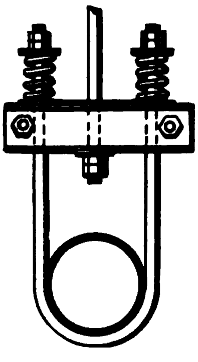


FIG. 16.—SIMPLE FORM OF SPRING HANGER.

It has been found advisable to assume that the spring will carry two-thirds of the load when in its open position, one and one-third times the load in its compressed position. Under these conditions a single spring for hanger No. 11 would carry two-thirds of 3,245 lbs. or 2,163 lbs. when open and 1 1-3x3,245 lbs. or 4,327 lbs. when compressed. The movement between the open position and the compressed position we previously found by the expansion table to be ½-in. If double springs are used, the movement will be the *same,* but for only one-half of the load, as each spring carries its own portion only.

On the lower hanger (No. 12) the load in the open position would be 2/3 of 2,360 lbs., or 1,575 lbs., while in the closed position the load would be 1 1/3 x 2,360 lbs. or 3,150 lbs.

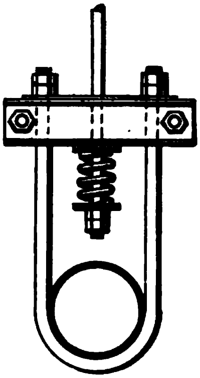


FIG. 17.—SPRING HANGER USING ONE SPRING.

This means that the spring will exert an upward thrust on the pipe when it is hot, but will not carry all of the load after the pipe has contracted; the difference between the loads carried in hot and cold conditions is transmitted, either down to the next hanger, or to some fixed point such as the heater connection. Yet, in any case, two-thirds of the load has been eliminated from the heater connection by the expansion and contraction action of the spring—something which cannot be accomplished by any other means.

Still another condition of expansion which must often be overcome is shown in Fig. 18, which is a plan view of two pipes joining together at the foot of a riser, pipe A expanding in the direction

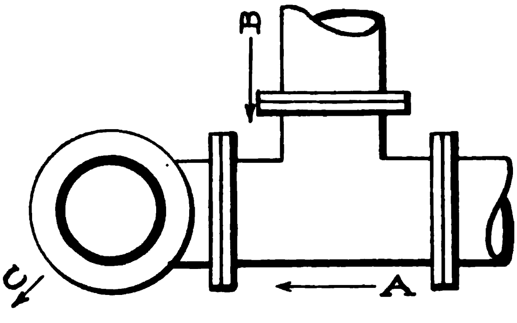


FIG. 18.—CONDITIONS OF EXPANSION REQUIRING CAREFUL TREATMENT.

indicated by arrow A and pipe B expanding in the direction indicated by arrow B; this gives a resultant expansion indicated by arrow C. If both of these pipes are heated and cooled together rollers can be placed under the base of the riser in such a way as to permit it to move back and forth along the direction indicated by arrow C, but if, by any possibility, these lines are valved in such a way that A may expand without B, then the riser moves in a direction indicated by arrow A, while if B is heated when A is cold the riser will move in the direction indicated by arrow B, the resultant movement indicated by C being attained only when both A and B expand together.

To accommodate such a condition (which is commonly met with at bases of exhaust lines or other large risers) a support can be used such as is shown in Figs. 19 and 20 which are side and end elevations of the piping shown in Fig. 18.

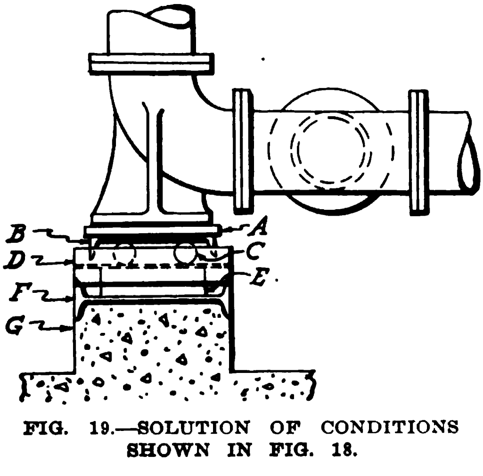


FIG. 19.—SOLUTION OF CONDITIONS SHOWN IN FIG. 18.

In Fig. 19 a base ell is first set on plate A which rests on the back of channel B. This channel is supported on two rollers C which allows movement in the direction indicated by arrow A, Fig. 18, these rollers rolling on web of I-beam D. I-beam D in turn is supported upon two rollers, E, turned at right angles to upper the rollers and moving over web of I-beam, F, which is supported on foundation, G; these lower rollers accommodate the expansion in the direction indicated by the arrow B, Fig. 18.

An end view, Fig. 20, indicates clearly how this support is made up, and it will be noted that the rollers are placed so as to make it impossible for them to slip out from under the riser, C rollers being retained by flanges on channel B and E rollers by flanges on I-beam D; similarly other flanges prevent rollers working out endwise and it will be found that this method of support will carry very heavy loads with only slight resistance to expansion.

Just a word in regard to the expansion table, Fig. 14. It will be noted that there are four lines showing expansion of pipe both "wrought-iron" and "cast-iron" and "covered" and "uncovered." The covered pipe is assumed to attain the same temperature as steam or other contents of pipe

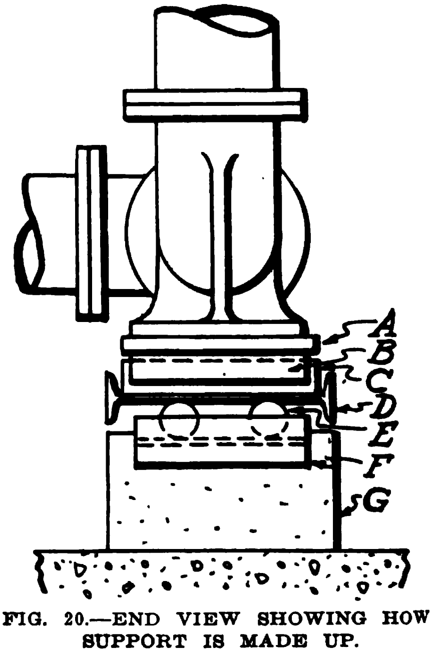


FIG. 20.—END VIEW SHOWING HOW SUPPORT IS MADE UP.

owing to pipe being protected by covering from cooling influence of surrounding atmosphere. Where pipes are uncovered it is assumed that the expansion is only two-thirds as much, owing to the outer skin of the pipe being cooled by air and, therefore, exerting a retarding effect on the expansion of the interior portions. This has been found to reduce the theoretical expansion approximately 33½%.

Window Leakage

Including Results of Important Tests on All Metal Windows

By Stephen F. Voorhees and Henry C. Meyer, Jr.

(Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 18-20, 1916.)

Almost all of the rules used in calculating the radiating surface necessary to warm a building, are based upon the assumption that the windows are reasonably tight. When wooden windows are used and it is found that the leakage is excessive, it is a simple matter to correct this fault by the application of weather strips. The introduction of the metal-clad window, that is, a wooden window covered with metal, has caused more or less trouble in heating buildings due to the difficulty of making a tight fit between the metal rubbing surfaces, but in this case also, methods of successful weather stripping have been developed.

The all-metal window, constructed of hollow or solid section members, is a most troublesome and serious factor, not only on account of its excessive leakage, but also because of its extensive use to meet the requirements for adequate fire protection.

EXPERIENCES WITH HOLLOW-METAL WINDOWS.

Several years ago one of the authors was called upon to design the heating and ventilating equipment for a building of some 5,500,000 cu. ft. capacity. When it was proposed to use hollow-metal windows, without weather strips, by the owners of the building, the heating engineer frankly stated that he was in a quandary as to the amount of heating surface necessary to warm the building on account of the variable, and at times, excessive leakage of windows of this type. After some discussion it was recommended that the rooms in the building be given about one-third more heating surface than would be required with reasonably tight windows, and if it was found that this increase failed to meet the situation, it would be better to attempt to stop the window leakage than to add still more radiating surface. Such a course was followed and it was found that in certain parts of the building the radiation supplied was not sufficient.

In another building for the same owners, the seven lower stories were equipped with hollow-metal windows and additional radiating surface was provided. The seven upper floors of the building were equipped with ordinary wooden windows made after the specifications and drawings of the architects, but with weather strips. When the building was finished, difficulty was experienced in heating the lower floors, but none whatever with the upper floors.

In all of the cases above mentioned the trouble was not experienced with all the rooms with the hollow-metal windows, showing, as was to be expected, that the leakage is a variable factor. This meant that in some rooms in which the leakage was more moderate, overheating occurred and naturally very serious overhetaing would occur in all of the rooms provided with an excessive amount of raditaion when temperatures were more moderate and with moderate outside wind velocity. This naturally produced a discomfort among the building occupants. Another interesting fact is worth recording in connection with the building first mentioned. This is exposed on all four sides and in severe winter weather, the draft from the windows along the west wall was so great and the temperatures at these points so low that it was impossible for one to sit in these locations with any degree of comfort. Along the east wall of the building, however, on the same floor and at points only 40 ft. away, temperatures of over 75° to 80° F. were found, as against temperatures of 60° to 65° F along the west wall.

SCOPE OF WINDOW LEAKAGE EXPERIMENTS.

For the purpose of determining the relative merits of several methods of reducing this window leakage, the architects for the buildings mentioned, Messrs. McKenzie, Voorhies and Gmelin, began what has resulted in an extended series of experiments on window leakage. These tests have extended over a period of some twelve months and cover a large number of experiments on different types and different makes of windows, many of the windows being tested under variable conditions. When the tests were started it was supposed that practically all the air leaked through the crack between the sash and the frame and between the meeting rails; that is, it took place around the sash perimeter. It was soon found, however, that there was a very considerable leakage elsewhere than through the crack. The air came through the puttied joints of the glass, and through the connections of the muntin bars, and through the joints of the frame. Every window, therefore, was tested to determine the two classes of leakage, which are designated (1) "Sash perimeter leakage" and (2) "elsewhere leakage," the sum being the total leakage of the window.

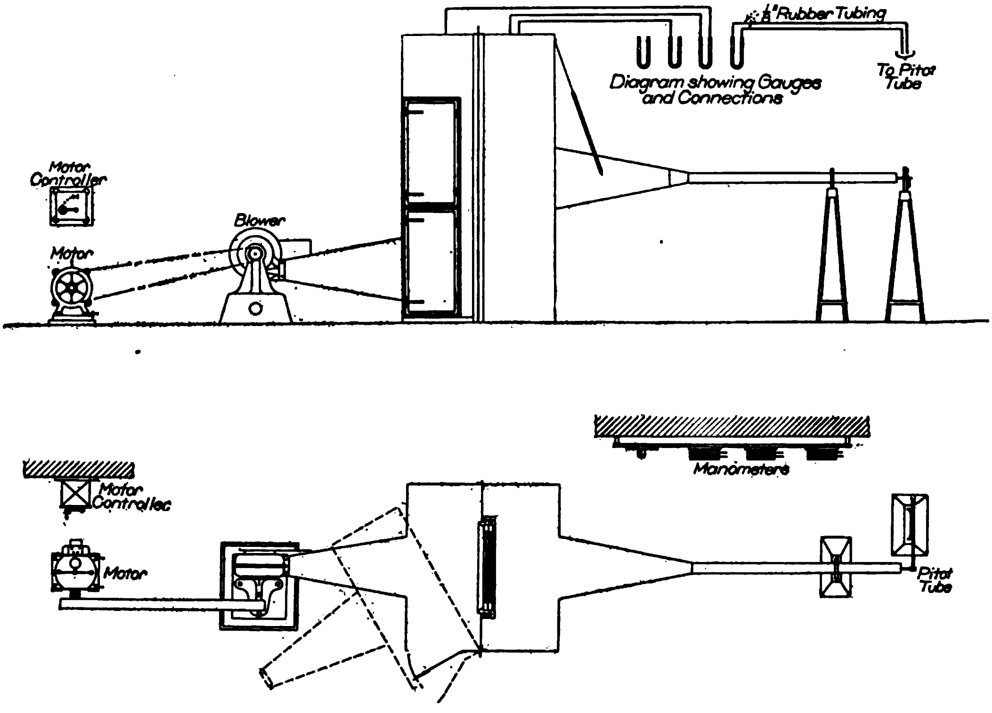


FIG. 1.—TESTING APPARATUS FOR DETERMINING AIR LEAKAGE THROUGH WINDOWS.

The tests were conducted in a space in the Chelsea Telephone Exchange building, with apparatus purchased for the purpose, by the New York Telephone Company. This apparatus consisted of a small Sirocco-type blower, belt-driven by a variable-speed direct-current motor. The window to be tested was placed in a partition separating into two parts a chamber made of galvanized iron about 5 ft. x 5.5 ft. in plan and 9.5 ft. high, and so constructed as to be practically air-tight. The fan was arranged to discharge into one side of the chamber. From the other side extended a conical galvanized-iron pipe terminating in a smaller pipe. A number of differential gauges were employed to record the pressure on each side of the window tested so that the differential pressure was obtained. Pitot tubes were employed to test the velocity of air through the discharge pipe mentioned. The quantity of air delivered by the fan could be varied by varying the speed of the fan and by throttling the inlet, and the pressures varied by the same means, also by sliding doors on the pressure side of the testing chamber. In each case tests were run at a number of different pressures and the results plotted on cross-section paper.

Fig. 1 gives a diagram and Fig. 2 a general view of the testing equipment and shows the blower, testing chamber and discharge pipe and the board on which the gauges are mounted. Fig. 3 shows the method of placing the windows to be tested in the chamber, the chamber being swung open on its hinges.

The general method of testing is to determine (1) the total leakage for the window as delivered by the manufacturer, and (2) to determine the elsewhere leakage by puttying up the cracks, thus eliminating the sash perimeter leakage. Deducting the "elsewhere leakage" as determined by the second test, from the total leakage, determined by the first test, gives the "sash perimeter leakage."

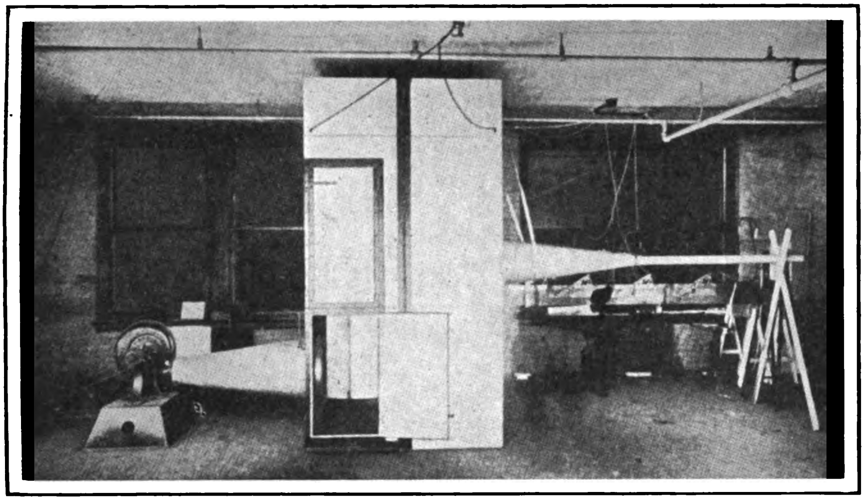


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FIG. 2.—GENERAL VIEW OF TESTING EQUIPMENT, SHOWING BLOWER, TESTING CHAMBER AND DISCHARGE PIPE.

Inasmuch as weather stripping affects chiefly the sash perimeter leakage, the architects have also called the curve showing this leakage the "100% strip;" that is, the curve would show the leakage of a window if the weather stripping is 100% efficient. Weather stripping will reduce the "elsewhere leakage," to some extent, particularly if the upper sash is stripped on weather side, so as to prevent air from entering the pulley holes in the frame.

Fig. 4, shows the results of a test on a hollow-metal window "C" and gives the leakage in cubic feet per minute on the horizontal scale for varying differential pressures indicated in the vertical scale. Test No. 13 is with the window as manufactured and locked Test No. 19 gives the test of the same window after a well-known make of weather strip had been applied. At a differential pressure of 1 in. the leakage was reduced from 134 cu. ft. to 96 cu. ft. or about 28% only. The window was then fitted with an inside wooden casement and the result given in Test No. 18a was obtained. The cracks in the sash were then puttied up and the so-called "elsewhere leakage" was obtained and this is given in, Test No. 21. Fig. 5 gives the results of tests on hollow-metal window "H." Test 38 and 47 were with the window plain. Tests 37 and 45 were made after weather stripping was applied.

Fig. 6 shows the summary of the principal results of most of the tests and gives the total leakage for the various windows tested. Fig. 7 gives the leakage through the perimeter of the sash only. In both cases the leakage is reduced to cubic feet per minute per linear foot of sash perimeter. Referring to Fig. 6 the poorest result is with a hollow-metal window plain, that is, without weather strips. Test A-5 is upon the same window fitted with a well-known make of weather strip. Test G-34 is an ordinary wooden window without weather strips and Test G-36 is the same window equipped with a well-known make of weather strip. Particular attention is called to this test as it represents in all probability about the leakage, perhaps a little less than most formulas for calculating radiating surfaces are intended to take care of. Most of the tests are of hollow-metal windows. Test No. D-24 is a metal-covered wooden window without weather strips. Test No. I-51 is for a patented pivoted window built of solid steel sections in which the leakage was found to be almost negligible and test L-56 is upon another make of pivoted window of solid sections where the leakage proved to be excessive.

An examination of the curves in Fig. 6 will show that at a differential pressure of 1 in. of water the leakage through some of the hollow-metal windows amounted to about 10.5 cu. ft. per minute, and 1.2 cu. ft. with the weather-stripped wooden window or nearly nine times as much.

EFFECT OF EXCESSIVE LEAKAGE ON HEATING REQUIREMENTS.

In endeavoring to find out what the excessive leakage meant in ordinary heating practice the author made the following calculation to find out, approximately at least, the leakage permitted by a well-known formula for determining radiating surfaces. The transmission through the north wall of a certain office building with 70° F. inside and zero outside, according to the method used by the late Mr. Alfred R. Wolff, amounted to about 57,000 thermal units per hour and the addition to this for "exposure" amounted to about 20,000 thermal units per hour in

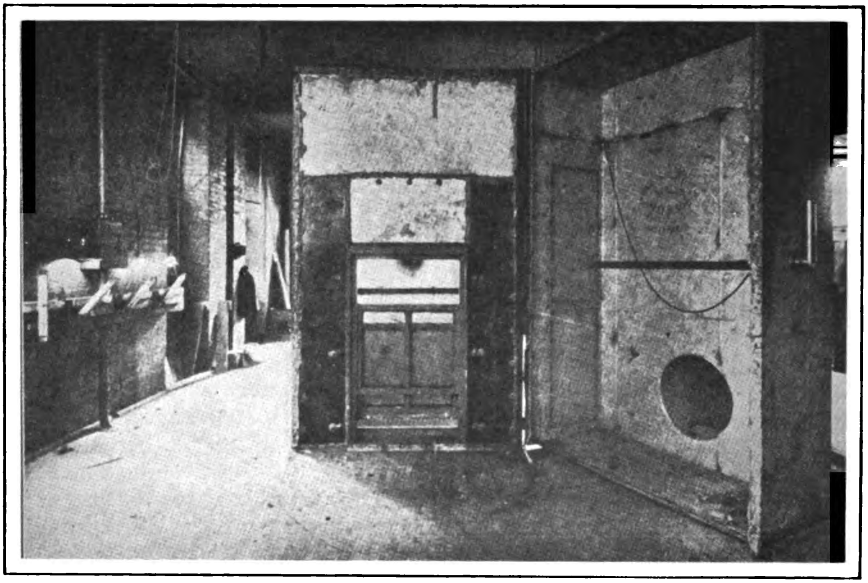

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FIG. 3.—METHOD OF PLACING WINDOW IN TESTING CHAMBER.

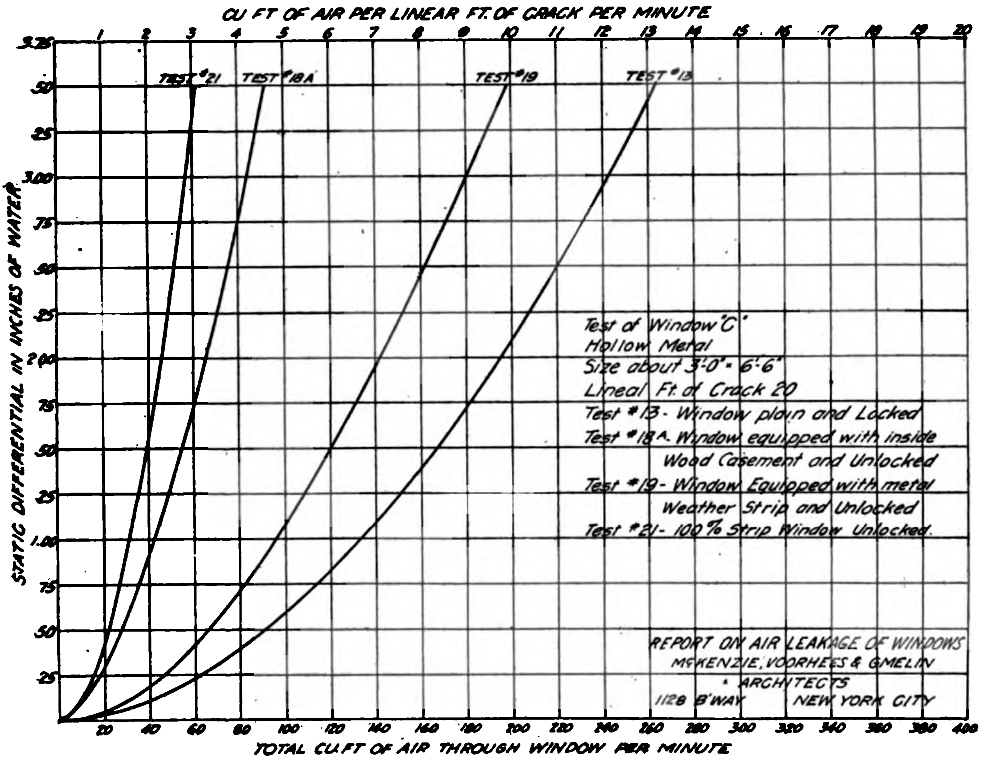

FIG. 4.—TEST ON A HOLLOW-METAL WINDOW, TYPE C.

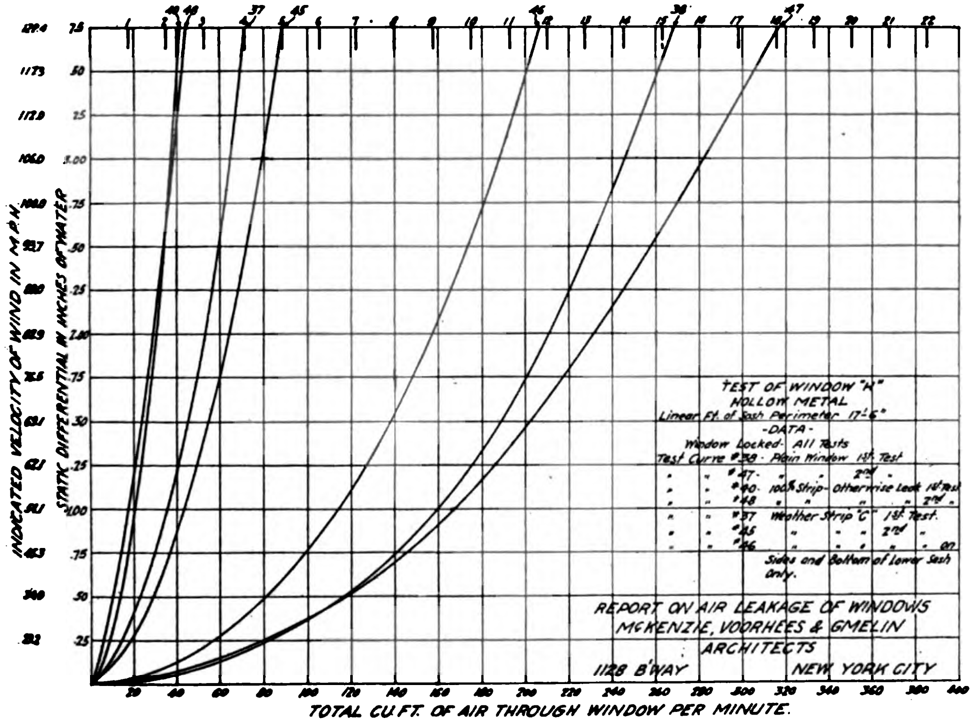

FIG. 5.—TEST ON HOLLOW-METAL WINDOW, TYPE H.

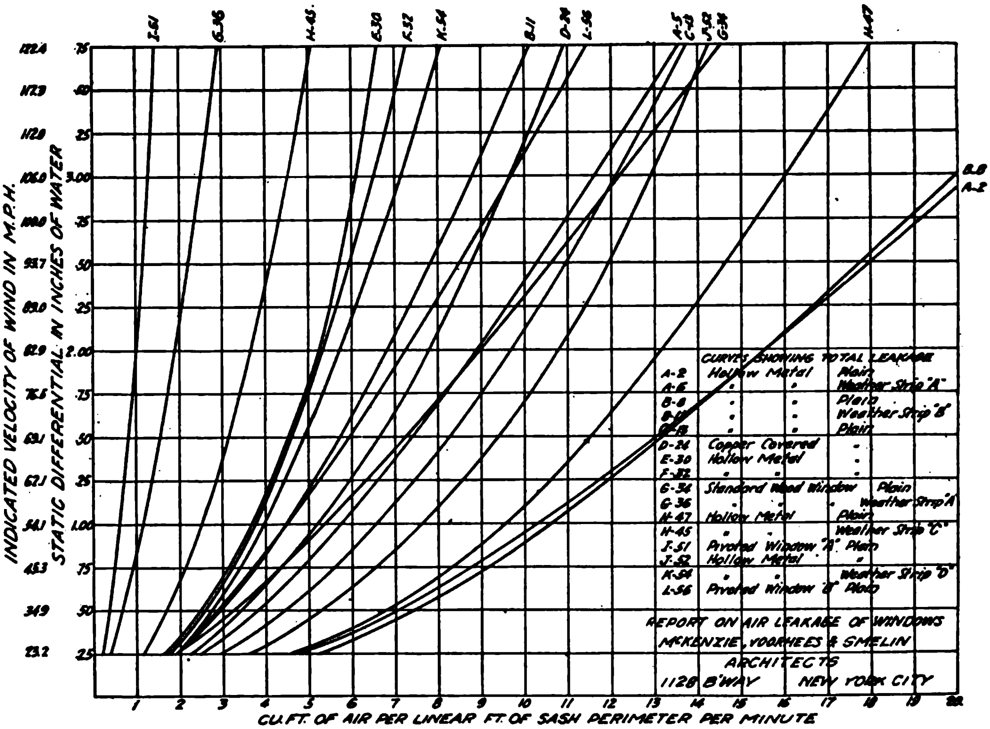

FIG. 6.—SUMMARY OF PRINCIPAL RESULTS OF TESTS, WITH TOTAL LEAKAGE FOR VARIOUS WINDOWS TESTED..

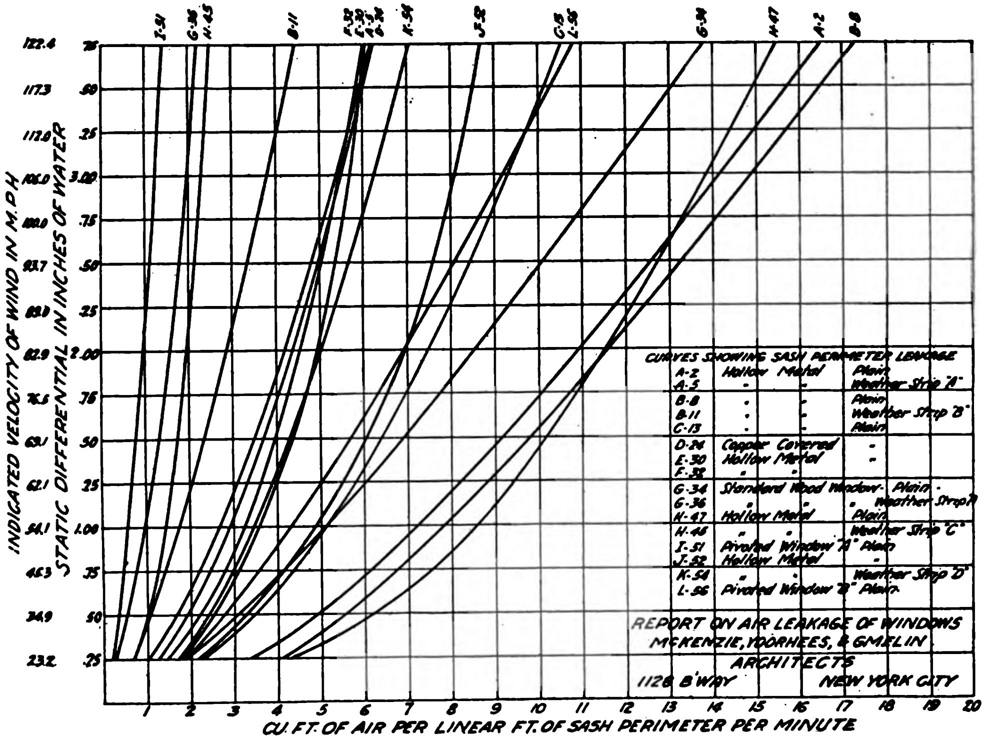

FIG. 7.—RESULTS OF TESTS FOR AIR LEAKAGE THROUGH PERIMETER OF SASH ONLY.

addition, the latter being added according to the author's understanding of Mr. Wolff's rule, to warm the inleaking air to room temperature. Now the perimeter of the windows in the north wall of this floor amounted to 400 lin. ft., hence we have:

$$\text{B. T. U per hour} = \text{Per. in ft.} \times \text{c.f.m. per ft.} \times \frac{70}{55} \times 60.$$

$$\text{C.f.m. per ft.} = \frac{20{,}000 \times 55}{60 \times 70 \times 400}$$

$$\text{C.f.m. per ft.} = 0.65.$$

WHY SOME OF THE EXCESSIVE LEAKAGE WOULD NOT OCCUR IN PRACTICE.

A comparison of this apparent permissible leakage with what actually occurred in the tests shows immediately that the excessive leakage found in some of the tests cannot obtain in practice and the reason for this is, of course, apparent. The tests covered the leakage with certain differences of pressure. It is difficult for this to occur in practice first because of the oblique angle at which a wind ususally strikes a building, and what is of greater moment the improbability of maintaining any great differences of pressure on both sides of window as they are usually employed in buildings. If a window forms part of the exposed side of a closed room, for instance, just as soon as leakage begins to occur due to outside wind pressure, the pressure begins to build up inside of the room and so reduces the differential pressure that causes the leakage.

While attention is drawn to the fact that the leakage as shown in the test cannot be reached in practice in so far as actual air movement is concerned, it is believed that the relation between the actual leakages of windows of different types is in the same proportion as in the tests noted. If, therefore, certain windows are apt to leak under severe outside weather conditions several times as much as a window that is reasonably tight, the matter at once becomes of vital importance to the heating engineer

With a variation in the possible window leakage such that the radiating surfaces required may be any amount from the normal to several times the normal surface required with reasonably tight windows the method of the heating engineer must become a matter of guess-work rather than the application of rules that have become more or less of an exact science. This matter is of far greater importance to the owner, however than it is to the heating engineer for he has to pay for the privilege of using leaky windows, the greater cost of the heating system and the greater fuel cost after the building is in use. Furthermore, the occupants of buildings so equipped have to endure the discomfort brought about by the excessive overheating in mild weather and in light winds brought about by the large amount of radiating surfaces required under extreme conditions.

What the architects who made the test are endeavoring to establish, is a comparative value or leakage factor for various types and makes of windows and to establish a standard of permissible leakage. It is to be hoped that the presentation of the data so far obtained will awaken an interest in the minds of heating engineers as to the importance of the subject, and will cause them to do what they can to create the demand for tighter and more serviceable windows.

Requirements for Model Compulsory Heating and Ventilation Laws

MINIMUM PROVISIONS FOR PUBLIC AND SEMI-PUBLIC BUILDINGS PROMULGATED BY THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

We take pleasure in presenting herewith the full text of the minimum heating and ventilation requirements which have been officially recommended for legislation by The American Society of Heating and Ventilating Engineers. The final draft of these requirements, as here presented, was completed by the council of the society recently and followed several preliminary reports dating from January, 1914, when the original committee was appointed to draft the necessary requirements.

The code now goes forth with the sanction of the society and is intended for use throughout the country in drafting compulsory ventilation laws, as well as in guiding the public generally in regard to the proper air conditions to be obtained in various classes of buildings.

Emphasis is laid on the point that the requirements as given are not intended to be the last word on the subject but as something tangible and definite and in line with the latest practice. As further progress is made, it is the intention of the society to develop the requirements still further.

Report of the committee appointed January, 1914, to prepare a set of minimum ventilation requirements for public and semi-public buildings which the society can can recommend for legislation.

GENERAL STATEMENT.

A correct interpretation of the experimental work which has been carried on, relating to ventilation practice, forces certain conclusions:

A. The necessity for adequate ventilation has been emphasized although the relative importance of certain factors has changed.

B. A high temperature, especially if associated with a high relative humidity, is injurious.

C. The proper relation between air temperature and relative humidity should be emphasized.

D. Air movement in contact with the body materially assists normal heat dissipation.

E. Air supply free from dust, bacteria and other contaminations is important.

We believe that the importance of the following requirements has been amply demonstrated:

1. A minimum allotment per person of floor and air space based upon the nature of occupancy.
2. A quantitative minimum air supply requirement.
3. A carbon dioxide test for determining the quantity of air supply and its distribution.
4. A temperature range limitation.
5. The removal from the air of injurious substances arising from manufacturing processes or other causes.
6. Air exhaust requirements for special service rooms (toilets, locker rooms, etc.).
7. Definite requirements regarding the drawing, filing and approving plans for both new and existing buildings, in which ventilating equipments are to be installed or changes in the equipment made.
8. Ample authority to enforce the law without recourse to civil action, and with sufficient operative and financial assistance to care for the clerical, field and technical details incurred by such enforcement.
9. The official body charged with the enforcement of such laws shall have authority to promulgate specific rules and regulations covering details of installation and operation not included in the law. Such rules and regulations must not conflict with the full intent and meaning of the law.

Your committee has decided that it would be impractical to attempt to draft a model ventilation law for reasons herein given, and because this would require an extensive building classification which could not be satisfactorily used in the various states, cities or towns where building laws and regulations, based on other classifications, are now in force. The committee submits herewith first (under Section I) the specific report covering general suggestions for minimum heating and ventilation requirements that are applicable to all classes of buildings, and second (under Sections II, III and IV) separate sets of more definite requirements for schools and colleges, factories and theaters.

Sections II, III and IV cover three very important classes of buildings, which are often the subject of separate legislation. Many other classes of buildings, such as Department Stores, Hospitals and similar institutions, Churches, Restaurants, Police Station, Jails, Bakeries, Laundries, etc., for which the requirements for heating and ventilation are covered by careful interpretation and use of Section I, would be benefited by separate sets of requirements. It is apparent also that suggestions from our society, covering practical requirements for the heating and ventilation of street cars and certain other public conveyances are desirable. This report could be considerably enlarged to cover these subjects.

The committee strongly urges that educational and co-operative methors of improving heating, ventilation and sanitation conditions be studied and used as far as possible in addition to compulsory methods.

The committee wishes to thank the various members of the society and others who have assisted in any way in the compilation of these recommendations. Whenever asked for, information was cheerfully given when such information was available. Acknowledgments are especially due the investigations and recent committee reports concerning the work in New York City and to the ventilation code and experience in the City of Chicago.

JAMES D. HOFFMAN, Chairman.
E. VERNON HILL.
FRANK T. CHAPMAN.

SECTION I.

General Suggestions for the Compilation of Laws for Compulsory Ventilation.

(Applicable to all Classes of Buildings.)

General: Sufficient and proper heating and ventilation shall be provided and maintained during occupancy in all rooms and all enclosed spaces, in all classes of buildings, to insure reasonable health and comfort conditions and maintain the requirements of Articles I to X inclusive.

Article I—Space Per Occupant (minimum requirement).

Schools and colleges—class, study, lecture and recitation rooms, floor area per occupant in square feet	15
Schools and colleges—class, study, lecture and recitation rooms, cubic space per occupant (volume divided by number of persons) in cubic feet	180

Primary schools—class and study rooms (pupils under 8 years of age), floor area per occupant in square feet	12.5
Primary schools—class and study rooms (pupils under 8 years of age), cubic space per occupant in cubic feet	150
Theatres, auditoriums and court rooms, floor area per occupant in square feet	6
Theatres, auditoriums and court rooms, floor space per occupant in square feet	90
Factories, manual training rooms and other work rooms—cubic space per occupant in cubic feet.	250

Minimum space conditions in all clases of buildings or rooms not tabulated shall be reasonable and pratcical and shall meet the approval of the Department of Health.

Article II—Air Supply (minimum requirement).

Sufficient outdoor air shall be provided for all occupied rooms or enclosed spaces at all times during occupancy, as may be necessary to meet the requirements of Articles I to XI, inclusive.

The supply of outdoor air for the following classes of rooms shall be positive and based on a minimum quantity of cubic feet per occupant per hour as tabulated:

Class, study, lecture and recitation rooms in all schools and colleges, cubic feet per occupant per hour	1,800
Theatres, court rooms and other auditoriums	1,200
Factories, manual training rooms and other work rooms.	1,500

All air supply for ventilation must be from an uncontaminated source or air from which the dust or other impurities shall be sufficiently removed by washing, or otherwise, subject to the approval of the Department of Health.

Article III—Air Distribution.

The distribution and temperature of the air supply for ventilation shall be so arranged as to maintain the temperature requirement, as stated in Article IV, without uncomfortable drafts, or any direct draft lower than 60° F., and as a test of proper supply and distribution, it shall be required that the CO_2 content shall not at any time exceed 10 parts in each 10,000 parts of air based upon tests of air samples taken in a zone from 3 to 6 ft. above the floor line in any part of the occupied spaces. This requirement may be modified by the Department of Health or other properly constituted authority as applying to breweries, water charging rooms or other rooms where carbon dioxide is liberated in manufacturing processes.

NOTE. While carbon dioxide in the air, in reasonable quantities, is not considered injurious to health, its presence in occupied rooms is an accurate measure of the air supply and distribution if no other source of carbon dioxide is present except the occupants of the room.

Article IV— Temperatures.

The temperature of the air in occupied rooms in all classes of buildings, during the periods of occupancy, shall be not less than 60° F., nor more than 72° F., except when the outside temperature is sufficiently high that artificial heating in the building is not required. This requirement shall not apply to foundries, boiler or engine rooms, or special rooms in which other temperatures are required or advisable as approved by the Department of Health.

Article V—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with the requirements of the Health, Fire, Building or Electrical Departments may be used both to warm the air supply for ventilation and to provide heat by direct radiation.

Article VI— Removal of Injurious Substances by Mechanical Exhaust.

Where dust, fumes, gases, vapors, odors, fibres or other impurities are generated or released in the course of a business or process carried on in any work room or other place in quantities tending to injure the health of occupants, there shall be provided canopies, hoods or other special devices, connected with an exhaust fan or fans of sufficient capacity and operated at sufficient pressure to remove such impurities at their point of origin. Such fans shall be kept running constantly while such impurities are being generated or released and shall discharge through ducts or flues to a point above the roof or otherwise and be provided with dust collectors or separators as may be necessary to safeguard the fresh air supply of the building or adjacent buildings and prevent any public nuisance. If practical and positive means, other than mechanical exhaust, can be devised for keeping these impurities from the air, such means may be used when formally approved by the Department of Health.

Article VII—Excessive Temperature and Humidity.

If, owing to the nature of the work done or the process carried on in a work room, factory, or other place of employment or occupancy excessive heat or humidity is caused therein, sufficient to be injurious to health, there shall be provided and maintained special means or appliances to reduce and control such excessive heat and humidity, subject to the approval of the Department of Health.

Article VIII—Special Service Rooms.

Public and semi-public locker rooms, coat rooms, dressing-rooms and wash rooms shall have exhaust ventilation equal to not less than six changes of air per hour, except where the window area opening directly to the outside air equals or exceeds ⅛ of the floor area of the room, subject to the discretion of the Department of Health.

Article IX—Toilet Room Ventilation.

(a)—Installations in New Buildings.

Every toilet room or every water closet or urinal compartment shall be ventilated directly to the outer air by a movable window or by skylight with fixed or pivoted louvres. Every such room or compartment shall have a window or glass skylight not less than one foot wide and of an area of at least six feet square for one water closet or urinal. For every such additional fixture the area of the window or skylight shall be increased by at least one square foot. The Department of Health may require mechanical ventilation in addition to the above requirement where under any special conditions the window ventilation is deemed inadequate. The Department of Health may permit the installation of toilet rooms, water closet or urinal compartments with less window or skylight area than specified in this paragraph above, or without direct connection to the outer air, if a mechanical system of exhaust ventilation is provided, maintained and continually operated. This mechanical system shall consist of metal or smooth masonry ducts from the individual toilet rooms or compartments, to a fan or fans of sufficient capacity to exhaust a volume of not less than 35 cu. ft. of air per minute for each water closet or urinal. If the air is exhausted from within two feet of each fixture this amount may be reduced to 25 cu. ft. of air exhausted per minute per fixture.

(b)—New and Existing Equipments in Old Buildings.

In existing buildings erected prior to the passage of this ordinance every toilet room or water closet or urinal compartment shall be ventilated to the outer air by movable window; glass skylight with fixed or movable louvres, or by ventilating duct. Whenever any such toilet room having more than two fixtures (water closets or urinals) is ventilated soley by ducts, or whenever the window or skylight area is one-third less than the area required for "new buildings" positive ventilation complying with the requirements of subdivision (a) of this Article IX shall be installed and maintained if so ordered by the Department of Health. The Department of Health may, at its discretion, modify this requirement for four or less fixtures, or may require ventilation for two or less fixtures.

(c)—All Installations.

Every window or skylight mentioned in (a) and (b) of this Article shall be so constructed and maintained as to be easily opened at least one-half of its required area for windows and one-fourth its area for skylights. All exhaust fans used for ventilating toilet rooms shall exhaust to the outer air above the roof or at such points as not to cause offense to the occupants of the building or any other building or to create any public nuisance in the neighborhood.

(d)—Air Shafts.

Whenever any air shaft for ventilating toilet rooms is covered by a skylight the net opening or openings available in such skylight shall be at least equal in area to the cross-sectional area of the shaft requirement.

Article X—Cellars.

All cellars, basements or spaces beneath buildings of any class or character shall be provided with windows or other adequate means of ventilation and such cellars or spaces shall be at all times properly ventilated and maintained in a dry and sanitary condition.

Article XI—Authorization.

The Department of Health is authorized to require additional or special ventilation or ventilating devices to cover any conditions which are unusual or require special treatment in occupied rooms or spaces in any class of buildings.

Article XII—Plans.

Before beginning the erection or alteration of any building the architect or contractor, owner, agent or party in possession or control, shall submit plans and specifications in duplicate showing and describing in detail the ventilating equipment contemplated. Such plans must be drawn to scale on cloth, in ink or by some process that will not fade or obliterate. The plans shall show accurately all dimensions and details and shall be accompanied by a written statement giving the number of occupants of each room and the use of the room unless the plans clearly indicate these facts. Such plan and specifications must be submitted and approved by the Department of Health before work is allowed to proceed. During the erection or alteration of any such building inspections must be made by persons duly authorized by the Department of Health and after completion a certificate shall be issued which states that the ventilating equipment of such building complies in all respects with the approved plans and specification and with the laws governing the same.

Article XIII—Officials Empowered to Enter.

The Commissioner of Health or his duly authorized assistants shall have the right to enter any building covered by the provisions of the ventilation law, at any reasonable time, and at any time when occupied by the public, in order to examine such building and judge of the condition of the same and to discharge his duties pertaining thereto, and it shall be unlawful for any person or persons to interfere with him in the performance of this duty.

Article XIV—Officials Empowered to Close.

Where it is discovered that any violation of the ventilation law is existing in any building the Commissioner of Health shall give due written notice to correct the same. If after a reasonable period this notice is not complied with the Commissioner of Health shall have the power and it shall be his duty to close and keep closed to the public any such building or part thereof so long as the conditions of violation exist.

NOTE.—It will be observed that the committee has used the term "Department of Health" throughout its report, and while the committee recommends that the enforcement of the laws be entrusted to local health departments in cities and to State Boards of Health in smaller towns it is evident that, in many cases, the enforcement will be vested in other bodies, in which case the proper name of the body authorized should be substituted for the term "Department of Health" used in the recommendations.

SECTION II.

Schools and Colleges.

(Special minimum heating and ventilating requirements applying to all Schools and Colleges. Supplementary to Section I.)

General: Sufficient and proper heating and ventilation shall be provided and maintained during occupancy in all rooms and all enclosed spaces in all classes of school and college buildings to insure health and comfort conditions, as required by the Department of Health.

Article I—Space Per Occupant.

a. A minimum of 15 sq. ft. of floor area and 180 cu. ft. of space per occupant shall be provided in each class, study, lecture, and recitation room, except that a minimum of 12½ sq. ft. of floor area and 150 cu. ft. of space may be accepted in class and study rooms for pupils under 8 years of age.

b. A minimum of 6 sq. ft. of floor area and 100 cu. ft. of space per occupant shall be provided in auditorium and assembly rooms.

c. Minimum space conditions per occupant in all classes of rooms not tabulated shall be reasonable and practical and shall meet the approval of the Department of Health.

Article II—Air Supply Per Occupant.

Sufficient outdoor air shall be provided for all occupied rooms at all times during occupancy as may be necessary to meet the requirement of Articles II to VII, inclusive.

A positive supply of outdoor air shall, while school is in session, be provided the following rooms and the quantity of this positive air supply shall be equal to, or be in excess of, the following minimum requirements per occupant per hour:

Class, study and recitation rooms	1,800 cu. ft.
Auditoriums, assembly rooms and libraries	1,200 cu. ft.
General and chemical laboratories	1,800 cu. ft.
Domestic science and manual training rooms	1,800 cu. ft.

Offices, reception rooms, libraries, teachers' rooms, retiring rooms, play rooms, corridors, gymnasiums and lunch rooms, shall be provided with approved ventilation, and the ventilation of gymnasiums shall be based upon a minimum of four changes of air in the room per hour, excepting in specific cases, where the Department of Health may have the power to modify this requirement.

The air supply for ventilation shall be taken from an uncontaminated source, or the air supplied must be air from which the dust or other impurities shall be sufficiently removed by washing, filtering or other approved method.

Article III—Air Distribution.

The distribution and temperature of the air supply for ventilation shall be so arranged as to maintain the temperature requirement of the following Article IV, without uncomfortable drafts or any drafts lower than 60° F., and as a test proper air supply and distribution, it shall be required that the CO_2 content shall not be alowed to exceed 9 parts in each 10,000 parts of air, based upon tests taken in a zone from 3 to 6 ft. above the floor line in the occupied spaces.

Article IV—Temperature.

The tempearture of the air in the various rooms and spaces within the building during the period of occupancy shall be maintained at all times throughout all occupied spaces within the ranges given in the following schedule, except when the outside temperature is sufficiently high that artificial heating in the building is not required:

Class, study, lecture and recitation rooms	66° to 67° F.
Auditoriums and assembly rooms	64° to 68° F.
General laboratories, domestic science and manual training rooms	62° to 68° F.
Gymnasiums	55° to 65° F.
Offices, reception rooms, teachers' rooms, retiring rooms	65° to 70° F.
Corridors.	60° to 70° F.
Play rooms, lunch rooms, locker rooms, wash rooms, dressing-rooms and coat rooms	60° to 68° F.
Toilet rooms	55° to 68° F.

For rooms not named the temperature range shall be 60° to 70° F. according to use.

The article shall not apply to outdoor school rooms termed "open air" school rooms. An accurate thermometer shall be provided and remain set and maintained at a height of 5 ft. from the floor against an inside wall of each class, recitation, study or lecture room. One such thermometer shall be placed and maintained in each laboratory, domestic science, and manual training room and at least two such thermometers in each auditorium, assembly room and gymnasium. Provide proper insulation between thermometer and wall.

Article V—Special Exhaust Ventilation.

There shall be provided for all laboratories, domestic science rooms or other rooms where gases, fumes or other special impurities are released in quantities tending to injure the health of the occupants, suction devices that shall remove such gases, fumes and other impurities from said laboartories, domestic science rooms or other rooms at or near the point of origin. Where the Department of Health shall deem it necessary proper hoods and ducts connected with exhaust fan or fans of sufficient capacity, and operating at sufficient pressure shall be provided to remove such impurities. Said fan or fans shall be kept running constantly while such impurities are being generated or released, and shall discharge at a point above the roof or otherwise as may be necessary to safeguard the fresh air supply for the building from contamination and prevent any public nuisance.

Article VI—Special Service Rooms.

General locker rooms, coat rooms, dressing-rooms and wash rooms shall have exhaust ventilation equal to not less than 6 changes of air per hour except where windows of such rooms open directly to the outside air are at least equal in area to one-eighth of the floor area of the room. In such cases the exhaust ventilation requirement may be modified under discretion of the Department of Health.

Article VII—Toilet Room Ventilation.

See Toilet Room Ventilation, Section I, Article IX.

Article VIII—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with the requirements of the Health, Fire, Building or Electrical Departments may be used both to warm the air supply for ventilation and to provide heat by direct radiation.

Article IX—Temperature Control.

Temperature control, preferably of an automatic type, is required for all heated and ventilated rooms. The temperature regulation, whether by automatic or hand control, shall be so arranged that its operation will not decrease the required volume of air supply for ventilation.

Article X—Moving Picture Machines.

Where facilities are given for moving picture machines, all ventilation and fire protection shall conform to Section IV, Article VI, and accompanying suggestions.

Article XI—Gravity Indirect Systems.

Gravity indirect heating and ventilating systems of approved design meeting the general requirements of this section II may be accepted for small school houses not exceeding eight class rooms in localities where proper motive power for positive mechanical ventilation is lacking, provided such gravity systems shall, with room tempeartures maintained at 70° F. and a difference of 40° F. between the temperature of the outside air and that of the air entering the room at the warm air inlet, be capable of supplying at least 30 cu. ft. of air per minute for each pupil accommodated in the room or rooms.

GENERAL SUGGESTIONS FOR SCHOOLS AND COLLEGES.

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters are made in Section I, Articles XI, XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge, to encourage the installation of liberal and high-class equipment in our schools for the public inspiration as well as for the health and comfort of the occupants.

In Article I, minimum floor space and volumes for laboratories, manual training and domestic science rooms were omitted because of the wide diversity of existing practice. Values which seem reasonable are:

Floor space, per occupant, 25 sq. ft.; volume, per occupant, 300 cu. ft.

In Article II, "air from an uncontaminated source" comprehends a supply of air, either normally pure as it enters the building or purified by some approved method before being distributed to the rooms in the building.

Elimination of dust from the air supply by means of air filters or air washers is desirable even under the best conditions and is absolutely imperative under some conditions of especially dusty air supply.

The controlling of relative humidity, within the range of 35 per cent. to 50 per cent. is desirable, wherever possible.

Rules for opening class room windows, under proper supervision, during recess periods are often valuable.

Strong emphasis is placed on the need of having the administrative feature of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation to require approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washers for air supply where the same is especially dust laden; to require fans in the auditorium to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the general legal ventilation requirements.

The Committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Section I, Articles XIII and XIV of this report (which have been of great benefit in the City of Chicago), or clauses to the same effect, be included in every ventilation law.

SECTION III.

Factories.

(Special Minimum Heating and Ventilation Requirements Applying to all Classes of Factories and Work Rooms. Supplementary to Section 1).

Definition.

Any building or room where persons are at work or employed in the manufacture, assembling or repairing of goods or materials which are not for their own family consumption or personal use shall be deemed a "factory" for the purposes of this Section.

General Requirement.

The owner or lessee or tenant or agent of a building used as a factory or in which a factory work room or work rooms are located, or the owner or lessee or tenant or agent of any work room in any building used for factory purposes, shall provide and maintain for every work room thereof and for all allied service rooms in connection therewith (such as office, stock, sorting, shipping, wash, dressing, locker and toilet rooms) good and sufficient ventilation and healthful temperature and humidity conditions at all times during working hours.

Article I— Space Per Occupant.

A minimum space of 250 cu. ft. per occupant shall be provided in all work rooms and no work room, of which occupancy is taken after the date of issuance of this provision, shall have less than a clear height of 10 ft.

Article II—Air Supply Per Occupant.

A positive supply of outdoor air from an uncontaminated source shall be provided the work room at all times during working hours, and the quantity of this positive supply of outdoor air shall be based upon a minimum requirement of 1,500 cu. ft. per hour per occupant introduced in such a manner as to fully meet the requirements of Articles III and IV.

Where the space per occupant is less than 1,000 cu. ft., or the window area, opening directly to out of doors, is less than 8 sq. ft. per occupant, a positive air supply shall be furnished by mechanical or other means.

Article III—Air Distribution.

The distribution of the fresh air supplied shall be so arranged as to maintain the temperature requirement without uncomfortable drafts, or any draft lower than 60° F. in occupied spaces. (See exceptions under the following Article No. IV.) One test of proper air supply and distribution will be that the CO_2 content in any occupied part of a work room shall not at any time exceed 10 parts in 10,000 parts of air, based upon tests of air taken in a zone of 3 ft. to 6 ft. above the floor line in any part of the occupied spaces. (See exceptions in Section I, Art. III.)

Article IV—Temperature.

The temperature of the air in the work room shall, at all times during working hours, be maintained throughout the actual working spaces, within the range of 60° F., to 72° F., depending upon the class of work and workers—except when the outside temperature is sufficiently high that artificial heating in the building is not required or when the particular class of work requires or makes advisable other temperatures that may be approved by the Department of Health.

The temperature of the air in offices shall be maintained during occupancy within the range of 65° to 70° F.; in wash, dressing and locker rooms during working hours, 60° to 70° F.; and in toilet rooms 55° to 68° F.

Accurate thermometers shall be provided, set and maintained at a height of 5 ft. from the floor of all work rooms, at least one thermometer for every 2,000 sq. ft. of floor area. Provide proper insulation between thermometer and wall.

Article V—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with requirements of the Health, Fire, Building or Electrical Departments, may be used both to warm the outdoor air supply and to provide heat by direct radiation.

Article VI—Special Service Rooms.

Locker, wash, dressing and coat rooms shall be ventilated in a manner approved by the Department of Health. See Section I, Article VIII.

Article VII—Removal of Injurious Substances by Mechanical Exhaust, or Other Practical or Positive Means.

Where dust, fumes, gases, vapors, odors, fibres or other impurities are generated or released in the course of a business or process carried on in any work room or other place in quantities tending to injure the health of the occupants, there shall be provided canopies, hoods or other special devices, connected with exhaust fan or fans of sufficient capacity and operated at sufficient pressure to remove such impurities at their point of origin. Such fans shall be kept running constantly while impurities are being generated or released, and shall discharge at a point above the roof or otherwise if so directed by the Department of Health and be provided with dust collectors or separators as may be required to safeguard the fresh air supply of the building or adjacent buildings and prevent nuisance in the neighborhood. If practical or positive means, other than mechanical exhaust, can be devised for keeping these impurities from the air, such means may be used when formally approved by the Department of Health.

Whenever the amount of air exhausted by suction devices to meet the above requirements exceeds the amount of air supply required for ventilation, the air supply for ventilation shall be increased sufficiently to prevent undue air in-leakage.

Article VIII—Excessive Temperature and Humidity.

If, owing to the nature of the work done or the process carried on in a work room or any occupied space in any factory, excessive heat or humidity is claused therein, sufficient to be injurious to health, there shall be provided and maintained special means or appliances to reduce and control such excessive heat according to the requirements of Article IV, and the relative humidity shall not be permitted to exceed 65 per cent. except when outside weather conditions prevent or when said rooms are used for special purposes which, according to the Department of Health require or make advisable other humidities.

Article IX—Filters and Air Washers.

If in the opinion of the Department of Health the air supply to any building is deemed impure or especially dust laden, filters, air washers or other appliances, satisfactory to the Department, must be provided.

Article X—Air Contamination from Gas Burners.

Where artificial or natural gas is burned in any occupied work room, it shall be the duty of the Department of Health to inspect, and said Department may require special or additional ventilation to overcome any objectionable condition.

Article XI—Toilet Room Ventilation.

See Toilet Room Ventilation, Sec. I, Article IX of the general heating and ventilating requirements.

GENERAL SUGGESTIONS FOR FACTORIES.

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters are made in Section I, Articles XI, XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge to encourage the owners and operators of said factories to provide as comprehensive, liberal and high-class equipment as possible, with a view to catering to the comfort, health and efficiency of the employees.

Elimination of dust from the air supply by means of air filters or air washers is desirable under the best conditions, and is absolutely imperative under some conditions of especially dusty air supply.

The controlling of relative humidity, within the range of 35 per cent. to 50 per cent. is desirable, wherever possible.

Rules for airing all work rooms during the noon hour by means of open windows is, under proper supervision, often valuable.

Strong emphasis is placed on the need of having the administrative features of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation to establish rulings within the law requiring approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washers, for air supply where the same is especially dust laden; to require fans in special places to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the general legal ventilation requirements.

Definite penalties, such as fines for minor offenses, up to a closing of the establishment for important or repeated violations, are certainly indispensable to get practical results.

The Committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Section I, Articles XIII and XIV of this report (which have been of great benefit in the City of Chicago), or clauses to the same effect be included in every ventilation law.

SECTION IV.

Theatres.

(Special Minimum Requirements Applying to all Classes of Theatres and Motion picture Houses. Supplementary to Section I).

Article I— Space Per Occupant (new places).

a. A minimum of $4^3/_8$ sq. ft. (must be at least 33 in. back to back of seats by at least 20 in. width of seat) of floor area as a seating space per occupant, exclusive of aisles and public passageways, shall be provided in the audience hall.

b. A minimum of 90 cu. ft. of air space, per occupant, shall be provided in the audience hall.

c. Aisles shall have in the aggregate a width of not less than 20 in. for each 100 seating capacity, and for fractional parts of 100, a proportionate part of 20 in. shall be added. No aisles shall have a width of less than 30 in.

Article I-A—Space Per Occupant (existing places).

a. A minimum of $4^1/_8$ sq. ft. (preferably 32 in. back to back of seats by 19½ in. width of seat) of floor area as a seating space per occupant, exclusive of aisles and public passageways, shall be provided in the audience hall.

b. A minimum of 80 cu. ft. of air space, per occupant, shall be provided in the audience hall.

c. Aisles shall have in the aggregate a width of not less than 20 in. for each 100 seating capacity, and for fractional parts of 100, a proportionate part of 20 in. shall be added. No aisles shall have a width of less than 30 in.

Article II—Air Supply Per Occupant (new places).

A positive supply of outdoor air from an uncontaminated source shall be provided the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based upon a minimum requirement of 1,200 cu. ft. per hour per occupant.

Article II-A— Air Supply Per Occupant (existing places).

A positive supply of outdoor air from an uncontaminated source shall be provided the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based upon a minimum requirement of 1,000 cu. ft. per hour per occupant.

Article III—Air Distribution (new places).

The distribution of the supplied outdoor air in the audience hall shall be so arranged as to maintain the temperature requirement without uncomfortable drafts, or any draft lower than 60° F., and as a test of proper supply and distribution, it shall be required that the CO_2 content in any part of such audience hall shall not at any time exceed 10 parts in each 10,000 parts of air, based upon tests taken in a zone from 3 ft. to 6 ft. above the floor line in the occupied space.

Article III-A—Air Distribution (existing places).

The distribution of the supplied outdoor air in the audience hall shall be so arranged as to maintain the temperature requirement without uncomfortable drafts, or any draft lower than 60° F., and as a test of proper supply and distribution, it shall be required that the CO_2 content in any part of such audience hall shall not at any time exceed 12 parts in each 10,000 parts of air, based upon tests of air taken in a zone from 3 ft. to 6 ft. above the floor line in the occupied spaces.

Article IV— Temperatures (both new and existing places)

The temperature of the air in the audience hall during period of occupancy shall be maintained at all times throughout all occupied spaces within the range of 62° F. to 70° F., except when the outside temperature is sufficiently high that artificial heating in the building is not required.

The temperature of the air in dressing-rooms, smoking-rooms, stage, ante-rooms, ticket offices, toilets and any occupied spaces other than the auditorium, shall be maintained as the special use thereof makes desirable within the range covered by Section I, of the general ventilation requirements.

Article V—Heat Sources (both new and existing places).

Any heat source which does not contaminate the air and which does not conflict with the requirements of the Health, Fire, Building or Electrical Departments may be used both to warm the outdoor air supply and to provide heat by direct radiation.

All stoves are prohibited and all gas heaters except when furnished with ample protection and adequate means for the removal of products of combustion are prohibited.

Article VI—Machine Booth Ventilation (both new and existing places).

Enclosures or booths for the motion picture machines shall be provided with exhaust ventilation having sufficient capacity to remove at all times not less than 60 cu. ft. of air per minute through a one-machine booth, not less than 90 cu. ft. of air per minute through a two-machine booth, and not less than 120 cu. ft. of air per minute through a three-machine booth. See Suggestions for theatres for further details.

Where picture machines, films and their equipment are passed as fireproof by the National Board of Fire Underwriters, the Department of Health may, at its discretion, modify the booth requirements.

Article VII—Air Exhaust System.

Attention is called to the general ventilation requirements for Special Service Rooms, Section I, Article VIII.

Article VIII—Toilet Room Ventilation (both new and existing).

See Toilet Room Ventilation, Section 1, Article IX.

GENERAL SUGGESTIONS FOR THEATRES.

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters are made in Sec. I, Arts. XI. XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements is compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge, to encourage the owners and managers of motion-picture shows to provide as comprehensive, liberal and high-class equipment as possible, with a view to catering to the comfort and health of the patrons and thus add to the popularity of the show place as compared with others which have barely come within the legal requirements.

The 80 cu. ft. of air space per occupant, allowed by the recommended regulations for "existing places" has been arrived at as an extreme minimum cubic space which should be allowed per individual when considering difficult cases of old established places. Ninety cu. ft. of air space per occupant is considered minimum for "new places."

A mechanical system of exhaust ventilation is desirable for the auditorium of a theatre in addition to the air supply system, but a mechanical system of exhaust ventilation is not made compulsory except where it may be necessary to meet the temperature and air distribution requirements.

The requirement for machine booth ventilation may be fulfilled by having a number of small metal screened openings (equipped with special dampers and automatic appliances with fusible link to automatically close tight in case of fire in the booth) on the sides of the booth near the bottom, aggregating 180 sq. in. for a one machine booth, 210 sq. in. for a two-machine booth, and 240 sq. in. for a three-machine booth, and a metal or other fireproof flue extending from the top or the side near the top of the booth and carried to a proper place of discharge outdoors. The size of this special fireproof vent flue shall be not less than 95 sq. in. clear area for a one-machine booth, not less than 120 sq. in. clear area for a two-machine booth, and not less than 144 sq. in. clear area for a three-machine booth, and in addition it shall be provided with an adjustable damper, operated from the booth and equipped with an appliance containing a fusible link or other device to operate so as to automatically open the damper wide in case of fire in the booth. Provide a metal duct equal in size to the special exhaust duct referred to for the different sizes of booths and connecting from out-of-doors to the bottom or lower part of booth for the introduction of out-door air directly to the booth. This duct shall pitch from the booth downward to the outside wall of the building, shall be provided at the inlet with proper louvres or weather protection hood, and shall have an adjustable damper near the booth, said damper to be controlled from within the booth and to be independently equipped with an appliance containing a fusible link or other device to operate so as to automatically close in case of fire in the booth. The machine booth ventilation shall be kept in operation at all times when the booth is in use.

Where picture machines, films and their equipment are passed as fireproof by the National Board of Fire Underwriters, the Department of Health may, at its discretion, modify the booth requirements.

Elimination of dust from the air supply by means of air filters or air washers is desirable even under the best conditions and is absolutely imperative under some conditions of especially dusty air supply. This question is dealt with by suggestion in the following general clauses.

The controlling of relative humidity, within the range of 35 to 50 per cent. is desirable, wherever possible, but the committee decided to omit from the regulations any humidity requirement in theatres.

Strong emphasis is placed on the need of having the administrative feature of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation to require approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washes for air supply where the same is especially dust laden; to require fans in the auditorium to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the general legal ventilation requirements.

Definite penalties, such as fines for minor offenses, up to a suspension or revoking of licenses for important or repeated violations, are certainly indispensable to get practical results.

The committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Sec. I, Arts. XIII and XIV of this report (which have been of great benefit in the City of Chicago) or clauses to the same effect be included in every ventilation law.

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WITH the publication at last of definite recommendations for a set of minimum ventilation requirements for public and semi-public buildings, which are recommended for legislation, perhaps the most important undertaking of its kind ever inaugurated by The American Society of Heating and Ventilating Engineers has been brought to a successful conclusion. This does not mean that the society has said the last word on the subject. It is more than possible that the requirements as promulgated will be amended from time to time, but the fact remains that the society has now gone on record as proposing something definite and comprehensive and based on the very latest researches covering the ventilation of buildings.

The history of the undertaking is interesting and shows how organized effort can stimulate and develop an idea. It will be recalled that all of the early efforts were to draft a model compulsory ventilation law that could be offered to the various legislatures for adoption. It was only after considerable study had been given to the subject that it was realized no model law could possibly cover the varying conditions in different classes of buildings. All this was brought out in the discussion of the proposed law and it seemed to many that the difficulties were insurmountable. Stimulated, however, rather than discouraged by the discussion, which, as the event proved, was essentially constructive, some one hit upon the clever idea of preparing a set of requirements from which the necessary legislation for a given locality or class of buildings could be prepared.

From that time the undertaking made rapid headway and although the requirements as drawn up were destined to pass through the ordeal of further searching criticism, which postponed the final publication of the recommendations for two years or more, it was probably worth the delay and gave the opportunity for making the final revisions which are seen in the finished report.

The code now goes forth with the imprimatur of the society and may be expected to become a valuable guide to boards of health, as well as to legislators of ventilating laws throughout the country. With its special sections on schools and colleges, factories and theatres, every type of building is taken care of in which the necessity for mechanical ventilation is an important factor.

Great credit is undoubtedly due the heating engineers' society for the completion of this code, but it seems to us that the trade and the public as well should know that the men who did the actual work in patiently developing the code to its final state were Prof. James D. Hoffman, of the University of Nebraska; Dr. E. Vernon Hill, of the Chicago Division of Ventilation, and Frank T. Chapman, of New York.

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

60—Radiation Supplied by Different-Sized Steam Lines.

Question: As I am interested in district heating, there has come to my notice a problem on this particular kind of work, and I would ask if you can furnish me with a table or formula giving the amount of radiation that can be taken off a high pressure line from 2-in. to 10-in. diameter, at a pressure of from 20 lbs. to 90 lbs. gauge, to supply low pressure radiation at 1 lb. to 3 lbs. gauge pressure.

Answer: There are many curves and formulae which will give the information, although perhaps not exactly in the form required. Konrad Meier, for instance, in his work on "Mechanics of Heating and Ventilation," gives complete charts and tables for 70 lbs. mean pressure. Factors are given in a table printed herewith for correcting the formula for friction, velocity and discharge for other mean pressures from 10 lbs. to 100 lbs., the mean pressure being, in this case, the sum of the initial and final pressures, divided by two.

The accepted transmission for radiators per hour, with a room temperature of 70° F., is 250 B.T.U. per hour, per square foot, per degree difference, with 2 lbs. average pressure. The total heat above 32° for 2 lbs. pressure, from the accompanying steam table, is 1,152.5 per pound, and the heat in the condensation at 190° would be 158 B.T.U. per pound above 32°, so that 250 ÷ (1,152 - 152) = 250 ÷ 994 = 0.251 lbs. of steam per hour per square foot of radiation at 2 lbs. gauge. Any other room temperature or steam pressure will give different results, but the method of determination still holds.

The discharge from any conduit with a flowing fluid is generally expressed in cubic feet per second, and is equivalent to the area multiplied by the velocity, for the unit of time. The quantities involved in the flow are as follows:

Pf = pressure in pounds per square inch to overcome friction, or the drop in pressure.
W = weight per cubic foot of steam at the mean pressure in the conduit.
V = velocity in feet per second, multiplied by 3,600 for feet per hour.
d = diameter of conduit or pipe in feet.
l = length in feet.
2g = force of gravity = 64.32.

The formula is:

$$Pf = \frac{W}{144} \, 0.0257 \, \frac{V^{1.95}}{2g} \, \frac{l}{d^{1.2}}.$$

Any quantity can be determined in the above formula, if the others are known. The chart referred to in Mr. Meier's book gives the quantities for all sizes and drops, in the form of curves. These are computed for 70 lbs. mean pressure, but may be corrected for other mean pressures by means of the factors.

In the above formula the velocity only is given and this would have to be multiplied by the area to obtain the cubic feet and as the weight of steam and its total heat varies with each pressure, the pounds have to be determined by the weight per cubic foot at the mean pressure.

The B. T. U. are determined from the pounds at the final pressure, and the total heat per pound, less the heat per pound in the condensation, which in this case was assumed at 190°. These quantities are given in the accompanying table for a few pressures.

The initial pressure will be the mean pressure, plus one-half the drop, and the final pressure will be the initial pressure minus the drop in the line.

In determining the specific weight the initial condition or total heat of the steam should be taken and the approximate loss by radiation from the main determined and subtracted from the initial heat per pound of steam delivered.

The total heat in the final steam per pound and the pressure will determine whether it is superheated or not, and the B. T. U. per pound discharged in an interval of time. This divided by 250 will give the square feet of radiation capable of being served.

When the pipe is small, with a great drop in pressure and high velocity, the loss by radiation per pound of steam delivered is less than the corresponding difference in B. T. U.

FACTORS FOR CORRECTING FORMULA FOR STEAM AT 70 LBS. MEAN PRESSURE, FLOWING IN PIPES FOR OTHER PRESSURES (KONRAD MEIER). ALSO STEAM DATA FROM MARKS AND DAVIS STEAM TABLES.

Gauge pressure, lbs.	Temp. of steam, deg. F.	Heat in liquid, B.T.U. per lb. above 32° F.	Weight of steam per cu. ft., lbs.	Latent heat per lb., B.T.U.	Total heat per lb. above 32° F., B.T.U.	Factor to correct formula.
Water	190	158.8	......	....	......	...
2	217	185	0.0404	967.2	1,152.2	...
10	237.8	206.1	.05907	953.5	1,159.6	3.06
20	257.6	226.2	.0818	940.1	1,166.3	2.23
30	273.1	242	.1043	929.2	1,171.2	1.76
40	285.9	255.1	.1263	919.9	1,175	1.47
50	297	266.4	.1482	911.8	1,178.2	1.27
60	306.7	276.5	.1699	904.4	1,180.9	1.12
70	315.4	285.5	.1915	897.7	1,183.2	1.00
80	323.4	293.7	.2130	891.5	1,185.2	0.91
90	330.7	301.3	.2343	885.8	1,187.0	0.83
100	337.4	308.3	.2556	880.4	1,188.7	0.77

at the final and initial pressures and the steam will be superheated at the final pressure. The properties of volume, weight and total heat, of course, are different than for saturated steam. This condition occurs when passing steam through a reducing valve.

When the loss by radiation in the main is greater than the difference in total heat corresponding to the initial and final pressures some of the steam has condensed in transit. This can be found in pounds by dividing one-half the total B. T. U. loss per pound of steam delivered by the latent heat at the mean pressure, and deducting this number of pounds from the discharge. The reason why only one-half is deducted is that this amount has been reduced to water at the center of the line, allowing a greater capacity for the gaseous steam.

In Question No. 53 (see THE HEATING AND VENTILATING MAGAZINE for November, 1915) this very problem is worked out in detail, only for lower pressures. The method is the same but the formula should be modified as suggested to meet the change in density of the steam.

Whatever heat in the steam is passed into a main, the same amount of heat is received at the end of the line, minus the B. T. U. loss in radiation. The friction formula simply gives the conditions, pressure, etc., of the steam, and the total flow is determined by the size, capacity and loss in pressure, due to friction.

◆

Heat from Sewer Gas.

A system of utilizing gas from a sewage tank for light and heat is described by Charles C. Hommon in *Engineering Record*. By capping the vents of the tanks of the sewage treatment plant at Atlanta, Ga., it has been possible to collect an abundant supply of gas and utilize it for lighting and heating the home of the author, who is chemist and bacteriologist in charge. The gas, it is said, has high calorific value and as a sewage plant by-product can probably be used in other ways advantageously to reduce the maintenance cost of the works.

◆

National Board of Fire Underwriters Adopts Rules Regarding Installation of Blower Systems.

An important action has been taken by the National Board of Fire Underwriters in adopting the requirements set forth by the National Fire Protection Association, covering the installation of blower systems for heating and ventilating and for stock and refuse conveying. This report was prepared by a committee composed of A. M. Feldman, New York, chairman; R. P. Bolton, J. A. Donnelly and others, and in the preliminary form, was published in THE HEATING AND VENTILATING MAGAZINE for May, 1914. The report has since been somewhat revised and was adopted at the last annual meeting of the National Fire Protection Association. Following is that part of the report, in its revised form, referring to blower systems for heating and ventilating:

Blower systems, which are often an economic necessity, usually introduce an additional hazard contributing to the cause and spread of fire, particularly when used for conveying stock and refuse. It is impossible to eliminate the fire hazard from such systems, but reasonable safeguards can be provided to reduce it.

The general standards applicable to blower systems are sub-divided into two classes: (a) heating and ventilating systems and (b) stock and refuse conveying systems.

CLASS A. HEATING AND VENTILATING SYSTEMS.

1. *Blowers* (the word blowers is used to include blowers and fans).

(a) Blowers shall be so located as to be accessible for repairing and lubricating.

(b) Casings to be strongly built and properly reinforced where necessary; joints shall be air-tight. Casings and runners shall be entirely non-combustible, and large enough not to require overspeeding. To prevent accidents, openings into casings shall be protected with substantial screens or their equivalent.

(c) Bearings and journals to be constructed in accordance with the best modern machine design and so proportioned as to prevent overheating. The bearings shall be self-oiled and so designed as to prevent leakage of oil. They shall be located outside of casings or ducts wherever possible. If located inside of casings or ducts, oilless self-lubricating bearings shall be used, made of bronze bushings fitted with plugs, such as graphite or metaline.

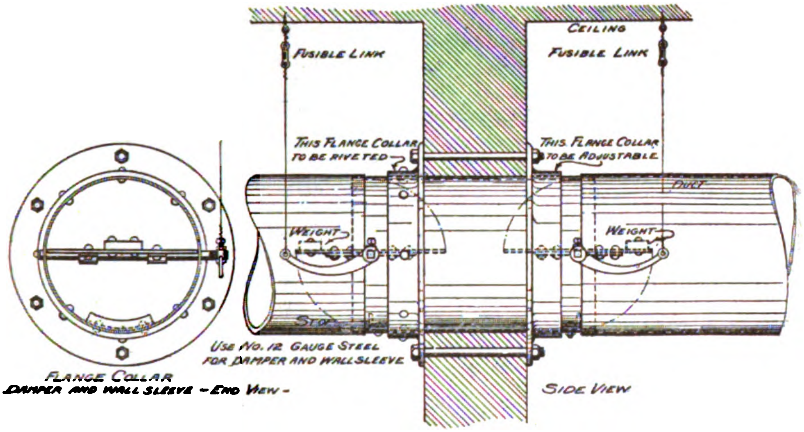

Ceiling
Fusible Link
Fusible Link
This Flange Collar to be riveted
This Flange Collar to be adjustable
Duct
Weight
Weight
Stop
Use No. 12 Gauge Steel for Damper and Wall Sleeve
Flange Collar
Damper and Wall Sleeve - End View -
Side View

FIG 1—AUTOMATIC DAMPER FOR DUCT OPENINGS IN FIRE WALLS.

2. *Ducts.* (The word ducts is used to include ducts, flues, pipes and tubes).

(a) Openings through floors for the circulation of air from one story to another shall not be used.

(b) Entire system of ducts to be self-contained; no rooms, hallways, attics, hollow spaces, voids, nor other portions of the building shall be used for air chambers or ducts, unless of fire-resisting construction, and then only by permission of the inspection department having jurisdiction.

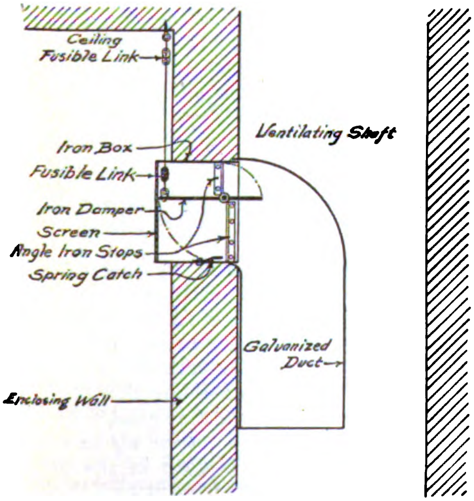


FIG. 2—TYPICAL AUTOMATIC DAMPER.

(c) Ducts shall be made of galvanized iron or other approved non-combustible material. The same applies to enclosures of steam coils used for heating air.

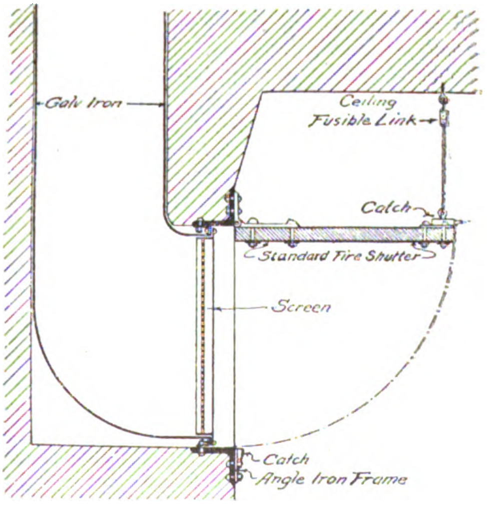


FIG. 3—TYPICAL AUTOMATIC SHUTTER.

(d) To be thoroughly braced.

(e) To be substantially supported by metal hangers, brackets or their equivalent.

(f) Where subject to mechanical injury, ducts to be properly protected.

(g) In no case shall the clearance between any metal ducts and combustible material be less than 1 in.

(h) The passing of ducts through fire walls should be avoided wherever possible. Where ducts pass through fire walls they shall be provided with automatic dampers, or national standard vertical automatic fire doors, located on each side of the wall through which they pass. (See Fig. 1).

(i) All ducts passing through floors shall be made of or protected throughout by approved fire-resisting materials, such as 4-in. brick, hollow tile, or 2-in. cement plastered partition supported by a substantial steel frame.

(j) Where vertical ducts serve more than one floor, automatic dampers shall be provided on all outlet openings directly from such vertical ducts, and at all connections with branch ducts from such vertical ducts (See Figs. 2 and 3).

(k) Joints between ducts and floors, walls or partitions, must be made tight by non-combustible material.

(l) Outlets on supply and exhaust ducts should always be protected by means of register faces or wire screens.

(m) Intake of air to be from outside except in re-circulating systems, and shall be taken only from areas containing non-combustible material. Intakes must be protected with rolling shutters or heavy doors.

Intake and intake rooms, steam coils and blowers, etc., shall be segregated in a room cut off by fire-resisting partitions from other portions of the building.

(n) Blower system should preferably have an emergency or automatic control to shut them down in case of fire. This may be done automatically by means of devices utilizing fusible links, thermostats, or automatic sprinklers. Such installations to be subject to the approval of the inspection department having jurisdiction.

3. *Ventilation of Cooking Appliances.*

(a) Ventilating ducts used to carry off the grease-laden vapors from hoods over cooking appliances, especially in kitchens of large restaurants and hotels, shall be constructed similiarly to boiler smoke flues, and, if of metal, must be of not less than No. 16 U. S. gauge, so substantially built that the grease and gum could be removed from the interior by burning out under a flash fire.

(b) The ventilating ducts shall be an independent system in no manner connected with other house ventilating systems.

(c) Ducts should not be connected to stacks, chimneys or flues used for other purposes.

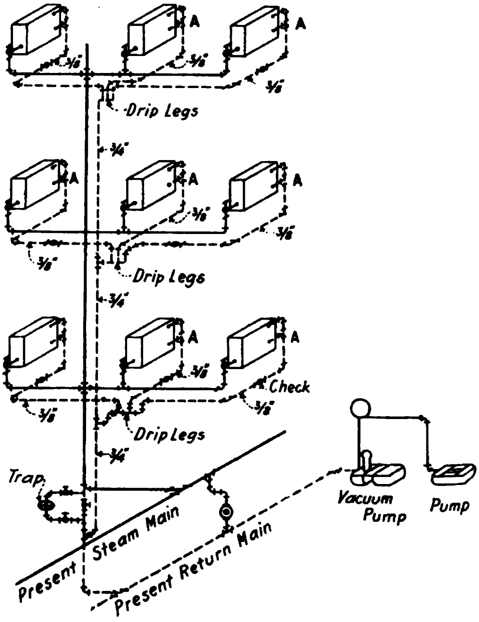
(d) A live steam jet should preferably be provided at the end of the duct nearest the cooking appliances.

CORRESPONDENCE

Simple Remedy for Noisy Heating System.

EDITOR HEATING AND VENTILATING MAGAZINE:

I want to call your attention to the fact that Mr. Ira N. Evans's solution of Question No. 54, in your "Consulting Engineer" department (THE HEATING AND VENTILATING MAGAZINE for December, 1915), was a great surprise to me, as I have great respect for Mr. Evans's ability as a heating engineer. He recommends the installation of a system of return risers, check valves, strainers and air valves on the radiators, the check valves and air valves interconnected. Then he places traps at the foot of each steam riser and a vacuum pump at the end of the return. If this is a simple (?) solution of such or any heating problem, it is beyond my comprehension!



SKETCH OF PROPOSED REMEDY FOR NOISY HEATING SYSTEM.

Check valves on a vacuum system would not work. Those nearest to the vacuum pump would short-circuit and the steam passing those checks would break the vacuum on the pump. Besides, if the checks are intended to pull out some of the water from the radiator by means of the pump, then why not the air be removed at the same time, as is done in any so-called Webster system? What remains for the air valves to accomplish?

Then again, as the air, which is heavier than steam, will have a tendency to escape through the check, would not the steam keep the air valve closed?

The only way to correct a poorly-designed up-feed one-pipe job is to enlarge and properly grade the radiator branches, even without increasing the tee outlets on the risers, but I would change the bushings on the steam connections of the radiators to eccentric ones. Then I would install a good air valve, without an air line. With steam at 2 to 3 lbs., as carried on that job, there is no reason why the air should be exhausted with an air pump. A. M. FELDMAN.

New York, April, 1916.

REPLY BY IRA N. EVANS.

Taking the criticisms in order, we have first the question of simplicity. This is largely a matter of individual opinion. The writer may rightly be taken to task for the use of this term, but he intended to convey the idea that the proposed changes could be made for a comparatively small sum, and with a minimum interference with the operation of the plant and with the occupants of the rooms.

The building in question is a transient hotel, with rooms intermittently occupied. It is composed of several old private residences thrown together and remodeled into one building. The risers are run mainly in the corridors, and several of the rooms are connected with long run-outs under the floor to the same outlet of the riser.

The job works fairly well on 1 lb. pressure or less at present, but gives trouble when the pressure is raised above that point, as is necessary in cold weather. The remedy proposed by the correspondent in the latter part of his letter would undoubtedly cure the difficulty, but there would be no job, as it would mean tearing up the floors to each radiator, removing carpets, to say nothing of the expense, which the owners would not consider.

A system of air lines to the air valves, with a vacuum, would not help matters, as it would tend to still further reduce the pressure at the far end of the radiators which would make them hang up worse than ever.

A return line vacuum system would involve a new system of returns, with traps or motor-seal valves at each radiator, while practically a new system of piping would be required in either case, with new radiator valves.

The remedy proposed by the writer involves no changes in the present piping, as the ⅜-in. pipe connection was to be made at the opposite end of the radiator from the supply, which is left undisturbed, by simply substituting an eccentric bushing for the present plug. The new pipe can be run inconspicuously above the floor along the base to the point where the riser is located. This would bring most of the construction work in the hallways, with a minimum of annoyance to the tenants.

The only cut in the risers is in the basement for the connection of the trap and new return riser, or air line, whichever one desires to call it. The return in the cellar running through store rooms, wine rooms and various crowded places, would not be disturbed, as the only connection would be at the end of the line in the engine room for the vacuum pump connection.

The correspondent must admit that the ¾-in. and ⅜-in. lines, with simple thermostatic traps at the base of each riser, would cost very much less than the remedy proposed by him.

Regarding the use of air valves, the writer stated in his original answer that "the additional connection from the air valve is not absolutely necessary," but as the connection was small and easy to make and might help, it was considered advisable to include it. Whether the air went out through the air valve or through the return would make little difference, so long as it all relieved.

Regarding the check valves the writer agrees entirely with the correspondent's statement as to their use in general. The purpose of these checks was to retard the movement of air and water in the returns of radiators on the same level and give the slow ones a chance to accumulate a column of water in the drip leg and overbalance the pressure on the supply in order to produce a flow. It is not shown on the sketch at the most advantageous point, which is at the bottom of the drip leg. With 18 in. or 20 in. of water in the ⅜-in. pipe, an additional pull of 1 lb. is produced on the return end of each individual radiator. These pipes are somewhat larger than necessary to produce the action described, but it is impractical to run pipe less than ¾-in. or ½-in. as they are apt to give trouble from stoppage and are too light structurally.

If a proper drip leg could be obtained in all cases, the checks would be unnecessary, but with varying conditions throughout the building, they were used to correct any possible inequality.

The vacuum on the pump and return line has nothing to do with these checks, as the lowest radiator is 20 ft. above the basement, and as the condensation fills the ¾ in. return in a solid column it will produce its own vacuum. The pump simply keeps the return lines clear in the basement. Where radiators on the first floor occur, separate thermostatic traps will have to be used before the return enters the main line to the pump.

If the sketch is carefully studied, it will be seen that each riser forms a heating system by itself, working on the principle of the steam loop, the radiator forming the cooling surface and the drip leg providing an individual column of water to counterbalance the drop in pressure in the radiator.

The water does not accumulate in the return of any radiator until the rate of condensation reduces the pressure below that in the suppy end. When the column becomes of sufficient weight to overbalance the pressure in the supply end, it flows down the ¾-in. return, accumulating velocity and pulling the air with it.

This is the same principle that actuates the Sprengles air pump which, when used with a column of mercury, served in the past to exhaust the air from electric light globes. It is also the same principle as that of the barometer condenser, the radiator forming the head and the ⅜-in. and ¾-in. pipe the tail pipe.

With the arrangement as shown, undoubtedly the greater part of the condensation would pass through the ¾-in. lines.

The writer agrees in general with all the statements made by the correspondent, but claims that he is also correct and that the arrangement as shown will accomplish the desired results with a minimum of expenditure and changes in the building or in the present piping.

◆

Cataloguing of Articles from Trade Papers by New York Public Library.

An item in the March issue stated that the 200 periodicals now on file at the New York Public Library are all examined as soon as received and index cards for the most important articles are made and filed in the library's catalogue. It was also stated that the library is glad to lend current periodicals for a brief period.

Attention should be called to the fact that this refers only to the Municipal Reference Library, 500 Municipal Building, New York, which is a branch of the New York Public Library, located in the Municipal Building for the convenience of the city departments and employees. At the main building, Fifth Avenue and 42d Street, upwards of 7,000 periodicals are regularly received, none of which can be loaned under any conditions or taken from the building.

◆

Civil Engineers Invited to Share Engineering Societies Building, in New York.

Negotiations are in progress between the United Engineering Society, representing the mining engineers, electrical engineers and mechanical engineers, on one hand and the American Society of Civil Engineers on the other to share the Engineering Societies Building, at 29 West 39th Street, New York. A committee of the civil engineers has made a report favoring the submission of the subject to the members for mail ballot.

The civil engineers' society now has its headquarters on 57th Street, New York, in a building of its own. The plans for cooperation include the joining of the library of the civil engineers with those of the other societies. There are now approximately two vacant floors in the Engineering Societies Building which the civil engineers could occupy, or the founder societies will, if necessary, build an addition on the top of the building.

◆

Sidewalk Ventilation Gratings Disapproved.

The use of sidewalk gratings for ventilating the new portions of the New York subway system has been definitely disapproved by the New York Public Service Commission. This action was taken after the plans for constructing the gratings were made and construction work well advanced, and also after the subway engineers had reported favorably on the use of the gratings.

The whole subject is now reopened and the commission voted to secure the services of an experienced engineer to assist in determining the most desirable method to be used. It will be recalled that the Broadway Association conducted an active campaign against the sidewalk gratings system on the ground that they would prove objectionable to passing pedestrians through the outflow of fetid air, as well as being depositories for the dirt of the street.

The public service commission has placed the solution of the problem in the hands of its engineering member, W. H. Hodge, of Boller, Hodge & Baird, consulting engineers, 149 Broadway, New York.

◆

Congress Urged to Prepare for Trade War.

Appealing directly to its members who, in a recent referendum, went on record as favoring increased foreign trade appropriations, the Chamber of Commerce of the United States has started a campaign in an effort to awaken Congress to the immediate necessity of commercial preparedness for the trade war for foreign markets. The immediate cause of the chamber's efforts are due to the failure of Congress to provide for the appointment of additional commercial attaches and trade commissioners, or for adequate administrative and clerical staff in the Bureau of Foreign and Domestic Commerce, for the study of markets outside of Latin America and separate appropriation for the maintenance of field stations in the United States, or for the application of the civil service law to the field service.

THE BUSINESS OUTLOOK.

V.

By Frank M. Huston,

Financial Editor of the Chicago Evening Post; Editor Rand-McNally Bankers' Monthly.

With unprecedented activity in nearly all lines of industry related to the metal trade, and with profits accumulating in an unprecedented manner and an enormous distribution in the form of wages, it is not surprising that this country should be speeding ahead along the highway of prosperity. The effect of the wide distribution of wages is already being realized, for this touches every line of industry by increasing the buying power of the wage earner.

Just now we are entering a new stage in our progress toward prosperity. The accumulations of profits from the steel mills and from the copper mines and allied industries are mounting up so fast that the time is not far distant when plans for their employment will be given serious consideration. This means an additional distribution of wages and of money for the purchase of materials. Should the war continue another year these considerations will be changed into a realization through heavy expenditures in plant extensions and the additional employment of men.

Already the United States Steel Corporation and the independent mills are putting their plans in force. It is estimated that upwards of $100,000,000 will be expended in increasing the capacity of the steel mills of this country. Between $50,000,000 and $60,000,000 has already been appropriated for that purpose by the United States Steel Corporation, of which $25,000,000 is expended at Gary in the new Indiana Steel Company plant. This appropriation is to be taken out of earnings so that it will be seen that the process is one of the distribution of the profits coming from the war business and the domestic business that has sprung up in this country in the last year, rather than out of new capital enticed from the hoardings of the thrifty.

In the copper industry the situation is equally favorable. Millions of dollars are being distributed as dividends and extra dividends and this goes to stockholders scattered all over the country, and this is an additional incentive and inspiration to broader and greater things. The Wall Street Journal recently estimated the gross war orders for forty-two companies since the middle of 1914 at $2,000,000,000, and twenty-six of these concerns aggregate $1,737,000,000. It estimates net profits on war orders run between 25 and 50 per cent. In addition to the money that has been distributed through dividends there has been an enhancement in market price of $919,323,000 on the outstanding securities of these twenty-six companies, or 71 per cent. This, if realized on, means a wider distribution of profits from the war and if continued as an investment means increased credit available to the holders.

Thus it will be seen that we are now beginning to reap the direct benefits that have accrued us through Europe's misfortune in a substantial way. Many corporations and business concerns which were struggling along to meet their obligations before the war began have been lifted out of their financial straits and placed upon a sound foundation.

Of course this has not taken place without the usual attendant inflation, which has been augmented to a very considerable degree by the change in our banking system. Nevertheless the ultra conservatism of our bankers, due no doubt to the uncertainty as to the ultimate effect of the change in our banking system, has held in check much of that wild speculation that has been experienced in former times of a sudden outburst of industrial activity.

With the prospects fair for a substantial agricultural production and with a very large "carry-over" from last year's unprecedented crop there is no reason to look forward to anything but a continuation of favorable business for a considerable time at least. Money is plentiful and rates are low and the business man who proceeds cautiously but relies on his courage to take care of the demand already in sight has every assurance of success in his enterprise.

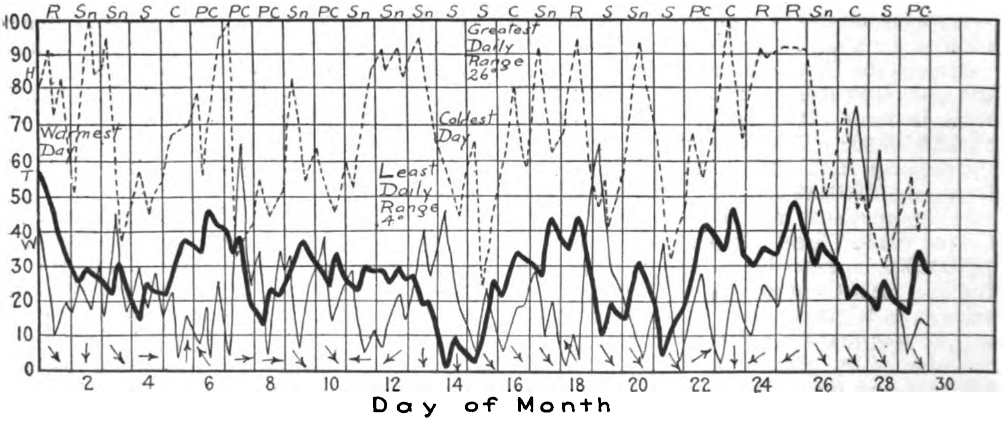
(Copyright, 1916, Kovnat.)

Heating Needs in China.

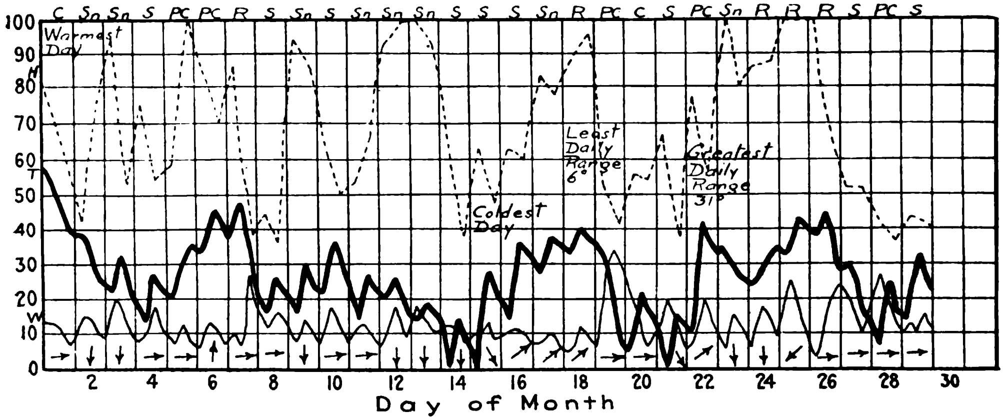
According to a report from Consul-General Edwin S. Cunningham there are at present not more than three buildings in Hankow in which heating plants are installed, but owners of a number of the older buildings would be glad to install modern plants if they were convinced that it could be done in a satisfactory manner. To get this business, he adds, it will not be sufficient for an American manufacturer to establish an agency for the sale of heating plants and plumbing material. The agency should employ a competent and experienced American or European for the purpose of installing the heating plants in such a manner that they will be efficient. An American, for many years a resident of Hankow, says that large buildings are now being constructed in the foreign concessions and plants more or less expensive are being installed. The Chinese, as they construct larger buildings, will employ foreign architects more or less, and will imitate then where they do not employ, and the persons ready to supply at once what is required, at the right price, will get orders in this line.

The Weather for February, 1916.

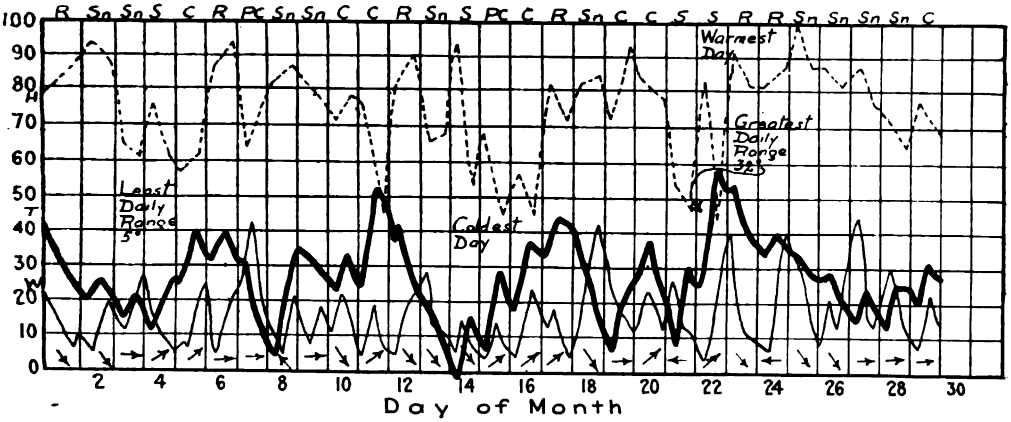
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest Temperature, degrees F.........	61	57	59	50	68
Date of highest temperature..............	1	1	22	22	22
Lowest temperature, degrees F...........	1	0	—1	—3	7
Date of lowest temperature...............	14	15	14	7	7
Greatest daily range, degrees F...........	26	31	32	23	30
Date of greatest daily range..............	15	22	22	18	19
Least daily range, degrees F..............	4	6	5	4	4
Date of least daily range..................	12	18	3	12	28
Normal temp. for month, deg. F.........	27.7	26	27	25	32.8
Normal mean temp. for month, deg. F....	30.7	28	31.8	25.4	33.6
Total rainfall, inches.....................	4.49	5.18	2.61	0.87	1.78
Total snowfall, inches....................	13.1	30.3	11.9	8	5.7
Normal precipitation, this month, in.......	3.87	3.56	2.75	2.24	2.86
Total wind movement, miles.............	14,266	8,548	8,883	8,536	8,699
Average hourly wind velocity, miles......	20.5	12.3	12.8	12.3	12.5
Prevailing direction of wind.............	N.W	W.	N.W.	W.	N.W.
Number of clear days.....................	6	9	4	10	9
Number of partly cloudy days............	7	8	4	5	8
Number of cloudy days...................	16	12	21	14	12
Number of days on which rain fell......	10	5	5	2	3
Number of days on which snow fell......	9	8	10	8	4
Snow on ground at end of month, in......	..	0.5	3.5	..	T.



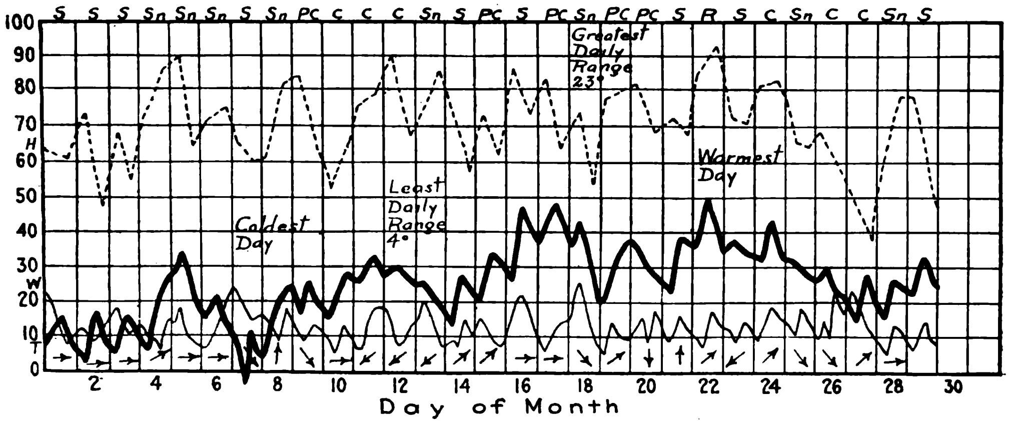
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1916.
(Hourly Observations of the Relative Humidity Are Platted on This Chart.)



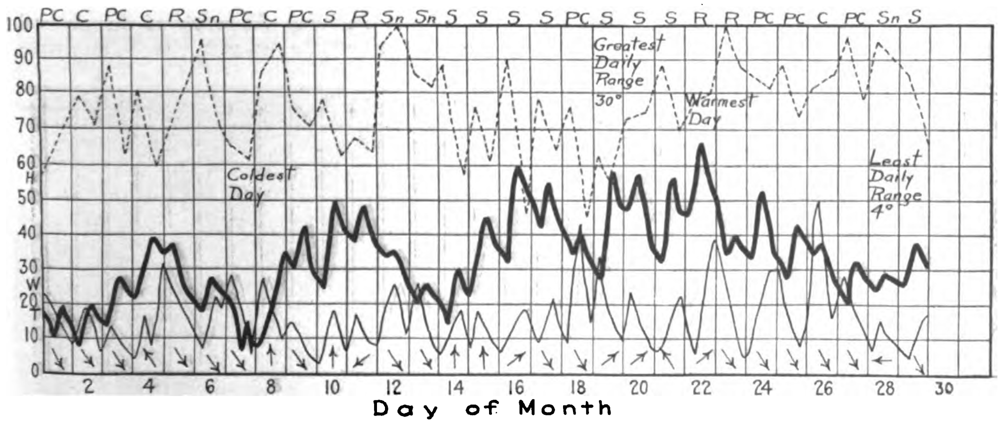
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1916.



RECORD OF THE WEATHER IN PITTSBURGH FOR FEBRUARY, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Mid-Summer Meeting of Society to Be Held in Detroit.

At a meeting of the council of the society, held March 29, it was decided to hold the society's mid-summer meeting in Detroit, Mich., during the week commencing July 16. The choice lay between Chicago and Detroit, and the fact that the Detroit members have been so active recently in forming a Michigan chapter of the society was considered a sufficient reason for accepting their invitation to visit Detroit this summer. The Chicago members, it was stated, when the matter was presented to them in this way, generously acquiesced in favor of Detroit.

Eastern Pennsylvania Chapter Organized.

In fulfillment of the plans of the organization committee, composed of J. T. J. Mellon, George W. Barr, E. T. Murphy and W. G. R. Braemer, a new chapter of The American Society of Heating and Ventilating Engineers, to be known as the Eastern Pennsylvania Chapter, was successfully organized in Philadelphia, March 8. The members and guests met at Kugler's restaurant where dinner was served in accordance with a unique set of specifications especially prepared for the occasion. These specifications, which were in typewritten form, each diner being furnished with a copy, were as follows:

SPECIFICATIONS COVERING ORGANIZATION BANQUET

General Description: The work to be done under this specification and accompanying plans includes the installation of a complete feed with all tools and appliances necessary for the manipulation of same, also the construction of an efficient and permanent organization looking towards the heating and ventilating of Eastern Pennsylvania with Camden as a by-product.

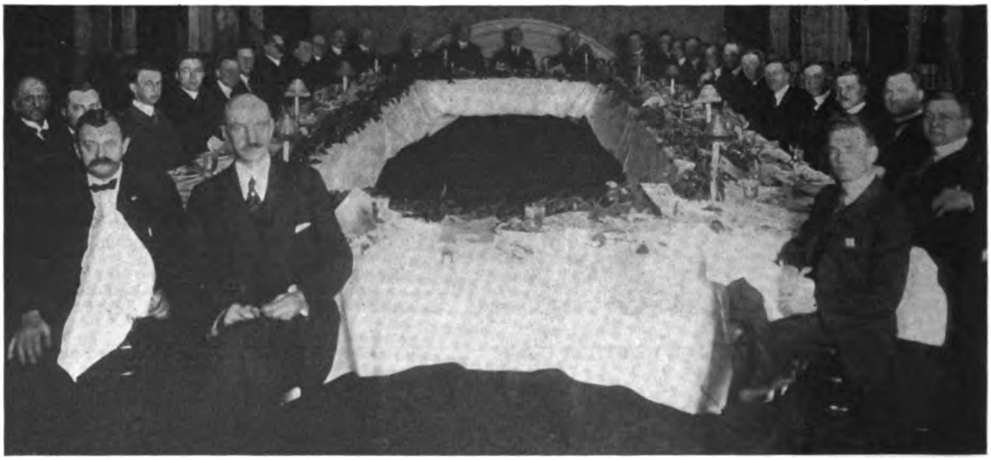
General Conditions: The work included under this specification is to be subject to the general conditions written for the entire set of specifications of the building of an American Society of Heating and Ventilating Engineers, whether attached to this part or not and the contractors are notified thereto as an integral part of their contract work.

Definitions: Wherever the word "feed" is used it is understood to mean the various luscious digestibles delivered to the festive board by the operating engineer trading under the name of "Kugler."

Wherever the word "contractor" is used it is understood to mean the party, firm or large corporation about to partake or who has partaken of the above-mentioned luscious feed, to which a whole or a part of the work embraced in this specification shall be awarded.

Workmanship: All work must be done with neatness and despatch, leaving no remnants of feed on the premises. To this end the contractors are particularly instructed to bring with them husky appetites and keen appreciation of the feed as it may appear from time to time during the progress of the work.

Co-operation: The relation of each part of the whole, including the work of the general construction of the chapter, the administra-



ORGANIZATION DINNER OF EASTERN PENNSYLVANIA CHAPTER, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

tion of its affairs, and promotion of its general good is to be carefully considered by the contractors. All parts of the work are to be arranged so as to harmonize in service and good will with all other parts.

Drawings: The work to be done is based on the attached drawings. It is understood that these drawings accompanying the specification are intended to show the general arrangement of the work, but the exact location and arrangement of all parts may be modified as the work progresses. The drawings and specifications do not undertake to illustrate every item necessary for the work as it is assumed the contractor is a gastronomical expert and capable of manipulating the feed without detailed instructions as to methods or tools to be employed.

Cutting and Patching: The contractors are required to furnish the necessary opening for the reception of the before-mentioned feed and to close same neatly while the *chew* is working.

All unused material shall belong to the contractors and shall be removed by them on completion of the work.

Testing: When the feed is all in place, the contractors' patience shall be severely tested with hot air, explosives, reports and other tortuous means as may be selected by the foreman of toasts.

Valves: This contractor shall absorb not less than five, nor more than six bi-valves. These are to be of the Jersey Coast Salt Type which may be painted with red lead or granulated horse-radish, as the contractor may elect.

Accessories and Trimmings: There are to be provided all the necessary accessories and decorations, such as green plumb bobs, bleached flax brushes, red bolt nuts, etc.

Grouting: Suitable foundations for the feed are to be prepared and a grout of not less than one-half pint of Mongolian soup mixed one, three, and five with Puree and Julienne, is to be poured in.

Insulation: The above-mentioned corporation is to be well insulated before filling, with a lining of granulated cork, thoroughly cleaned, after which is to be applied one coat of best metal leaf bronze finished in the Princesse style.

Cooling System: To be divided into a pre-cooler and a re-cooler. The pre-cooler is to consist of a Punch, well soaked in coal tar oil of apricot, from which all other impurities have been removed. If the contractor survives this, he is called upon later to absorb a re-cooler constructed of H_2O at 32° F. or less, direct-connected to chilled Keystone grease, tinted with red lead and yellow ochre.

Heating Plant: To consist of not less than one-half b(r)oiler, mounted on carbon and proteid foundations. In the space immediately surrounding same is to be provided fuel, such as starch of the Irish type, and pea and rice coal, mixed half and half. The latter is to be tinted with yellow ochre.

Packing: All crevices and spaces are to be well packed with natural grass, coated with cotton and oil, extract of hen, etc.

Painting: The entire job is to be given at least one coat of brown or black paint, as may be selected. This paint shall be an extract of the finest chicory and the contractor may be impelled to mix this with caseine and saccharine to prevent flecking or peeling when heat is applied.

Platform: The contractor will at this time be called upon to construct a platform upon which the organization will stand. The material for this platform is to be selected by a nominating committee appointed by the foreman of toasts with the contractors as the final arbitrator of their selection.

The contractors will also be called upon to select a more permanent set of specifications governing future work.

When the speechmaking began, Toastmaster George W. Barr told of the organization of the society itself in 1894, the project taking form through the action of the master fitters' organization in passing a resolution discouraging the presentation of technical papers at their meetings. This brought about the movement for the formation of a technical engineering society for the discussion of heating and ventilating matters. The first professional meeting of the society was held in January, 1895, and Mr. Barr reminded his hearers that this was just 21 years ago. He predicted a brilliant future for the Eastern Pennsylvania Chapter.

J. D. Cassell, who was then introduced, spoke of the opportunity before the new chapter of securing wider publicity for and appreciation of the profession. He referred to the appointment of commissions without engineers and considered this was due largely to the modesty of the engineer in making his capabilities known. He expected the new chapter to take an important part in the uplift of the society and of the heating profession.

The toastmaster then called upon Homer Addams, treasurer of the society, who expressed his gratification over the launching of the new chapter and looked to see the membership reach at least 100. He spoke of the high class of men who were coming into the society, recent applicants including Dr. W. S. Jacobus, president of the mechanical engineers' society, John A.

Stevens, chairman of that society's boiler code committee, and others.

A. C. Edgar was introduced as one of the society's charter members. He stated that he was glad to be present on this occasion, which he felt was equally as auspicious as that of the society's first meeting which he attended.

Frank K. Chew also spoke, and told of the work accomplished by the other chapters and of the opportunities of the Eastern Pennsylvania Chapter.

A nominating committee was then named consisting of A. C. Edgar, H. P. Gant and H. C. Beatty. This committee reported the following ticket which was unanimously elected:

President, J. D. Cassell; vice president, Isaac H. Francis; secretary, George W. Barr; treasurer, Kennedy Duff. Board of governors: J. T. J. Mellon, W. G. R. Braemer and E. T. Murphy.

It was decided to hold the chapter meeting at the Engineers Club, 1317 Spruce Street, the second Thursday of each month, the April meeting being scheduled for April 13. The following were present: Eilert Nesdahl, E. Kessler Webster, Harry C. Beatty, Herbert A. Terrell, W. G. R. Braemer, G. W. Barr, E. S. Berry, J. D. Cassell, August Geiger, A. S. Mappett, J. T. J. Mellon, W. G. Culbert, B. H. Davis, Robert L. Young, William W. Rice, George Boon, Arthur P. Goldsmith, I. F. Grumbein, E. T. Murphy, Lee Nusbaum, William H. Timm, Richard D. Burns, H. P. Gant, William J. Robinson, Kennedy Duff, A. C. Edgar, Horace A. Kottcamp and Joseph A. Waddell, Jr.

The guests of the evening were Homer Addams, Frank N. Chew and George G. Schmidt.

Permanent Organization of Ohio Chapter.

Officers of the newly-formed Ohio Chapter for the ensuing year were elected as follows, at a meeting held in Cleveland, March 10:

President, Robert S. Mayer; vice president, M. L. Crowell; secretary F. G. Phegley, 706 Rose Building; treasurer, F. H. Valentine. Governors: J. H. Bacon, W. C. Green and W. M. Kingsbury.

Car Heating Discussed by the Illinois Chapter.

Car heating, including railroad coaches and street cars, was the topic for discussion at the March meeting of the Illinois Chapter. The meeting was held March 13 and followed a dinner at the Morrison Hotel, Chicago, with President D. L. Hogan in the chair.

The first speaker was Elmer W. Reitz, of the Chicago Car Heating Co., who described the development of railroad coach heating, leading up to the vapor method now in almost universal use by the railroads. The advantage of the vapor system, he said, is the elimination of the danger of freezing which is of the greatest importance due to the standing of empty coaches in cold yards for more or less lengthy periods. The customary practice is to have a row of pipes extending the length of the car on each side, usually ten pipes each 70 ft. long, controlled by four valves. The speaker stated that it was usual to open the ventilators rather than to shut off the heat in the cars.

D. I. Cooke, who is a member of the Illinois Chapter, covered the subject of street car heating, using numerous stereopticon slides to illustrate the various methods in use.

Fifty members and guests were present.

An effort is being made by a "boosters' committee" of the chapter to increase the chapter's membership, as well as that of the society, by interesting many representative heating and ventilating engineers in the Middle West who are not at present society members.

March Meeting of New York Chapter.

The success of the dinner meetings of the New York Chapter was attested by another large attendance at the March meeting which was held in the rooms of the Building Trades Employers' Association, on 33d Street, New York, March 27. No technical topics were taken up, the evening being devoted to a short business session, followed by after-dinner talks. President W. H. Driscoll acted as toastmaster.

The report of the nominating committee placed the following in nomination, the election to take place April 24: For president, J. J. Blackmore and Arthur Ritter; for vice-president, Frank K. Chew and Perry West; for secretary, A. S. Armagnac and F. K. Davis; for treasurer, R. B. Hunt and W. J. Olvany; for board of governors (three to be elected), A. M. Feldman, George W. Martin, W. H. Driscoll, Conway Kiewitz, C. E. Pearce and Richard Ruppell. It was announced that the April meeting will be in charge of a special committee, headed by P. H. Seward, representing the board of governors, and that future meetings will be conducted on the same plan.

The first speaker was A. S. Armagnac. Mr. Armagnac stated that however great the need of co-operation on the part of the chapter members in engineering matters, the first requisite is a closer acquaintance with each other and this, he thought, was being accomplished by the present method of conducting the chapter meetings. He then called attention to a number of topics of the day, such as the approaching meeting of the National District Heating Association in New York, and declared the trade would find much of interest in the program of the association's meeting. Speaking of other topics, he referred to the plans of the British institution to establish additional "British Standards" in heating and ventilating work, and he asked why it was not possible to establish some American standards. "Why not a 'A.H.L.C.' (American heat loss coefficient)," he said, "if we are to have standards of this kind?" Other topics discussed by him were the present status of the New York subway ventilation situation and the national advertising campaign of the American Warm Air Heating and Ventilating Association.

The next speaker was Homer Addams, treasurer of the society, who gave an interesting review of the coal industry in the United States. He declared we are rapidly coming to the use of bituminous coal for all types of heating plants. Mr. Addams, in dealing with the coal industry, related a number of his own experiences, during his early connection with the industry.

The toastmaster then called on Charles E. Carpenter, president of the E. T. Houghton Co., of Philadelphia, who made a thoughtful address on the subject of the initiative, referendum and recall. Incidentally he gave some significant Philadelphia statistics, refuting Philadelphia's reputation of being a sleepy town. "If we do this when we are asleep," he added, "God help you if we ever wake up."

William J. Baldwin, who spoke next, presented a number of designs made by him for a chapter badge. He said the designs were only intended to start the ball rolling and that he hoped to see an effective badge evolved and adopted by the chapter. Speaking of the recent agitation for a change to the metric system and also from the Fahrenheit to the Centigrade thermometer scales, he expressed himself as opposed to any such change, declaring that our present system of weights and measures, etc., was too well ingrained and used to make a change feasible. Especially in connection with long measure, he declared the use of the metric system would play havoc with all our surveys of every sort and would create chaos throughout the land.

George W. Martin concluded the speaking by emphasizing the advantage to the members of attending the forthcoming meeting of the National District Heating Association. Among the papers, he said, which would be of special interest was one on "Relation of the Central Station Steam Company to Its Customers," by William J. Baldwin, Jr., consulting engineer for the New York Steam Company.

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"British Standards" for Heating and Ventilating Work.

In connection with the elaborate plans for research work on problems bearing on heating and ventilation, which have been undertaken at the University College, in London, Sam Naylor, the new president of the British Institution of Heating and Ventilating Engineers, stated in his address before that body, that the standardization of all things appertaining to heating and ventilating was the most important work undertaken by the institution. "During the last few years," he added, "a new vista has opened to us in the research work being done at the University College and in the near future there is a prospect of important results being available to the members for their daily use and assistance. It is important that these standards should be accurate—accurate by experiment and not by deduction or calculation—so that time will necessarily be required, for accuracy is more important than speed. I venture to think that when this work is accomplished, the 'British Standard' will be the textbook of the world, and the boasted knoweldge of Continental rivals will be found to be not altogether without faults."

The summer meeting of the institution will be arranged for by the council. The autumn meeting is scheduled for October 10 and the next general meeting for February 12, 1917, at the Holborn Restaurant, in London.

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New York School of Heating and Ventilation Holds Fourth Annual Dinner.

The completion of the fourth year of the class conducted by Charles A. Fuller under the name of the New York School of Heating and Ventilation was celebrated with a dinner at Stewart's Restaurant, New York, March 13. Covers were laid for 134 guests who took advantage of the occassion to endorse the work done by the leader of the class, Mr. Fuller, and to make it a rallying point for further efforts in the same line, both in New York and throughout the country.

Among the speakers were Frank K. Chew, Milton W. Franklin, W. H. Driscoll, J. J. Blackmore, Charles A. Fuller, James A. Donnelly, C. W. Obert, A. H. Bosworth and H. H. Pratt. One of the points brought out by Mr. Franklin was the need of absolute honesty on the part of the engineer if he was going to reap the full reward of the opportunities that were now opening up to him as a result partly of the European war and partly through the wider recognition of the services of the engineer.

President W. H. Driscoll of the New York Chapter, spoke of his own early experiences when the science of heating was hardly more than a rule-of-thumb proposition and declared that the work of the school was helping largely to meet the demand for more scientific methods in heating engineering work.

J. J. Blackmore, until recently secretary of the heating engineers' society, said that the success of the school emphasized the fact that the society should have taken the initiative in starting this work, but that the outlook for society work in this direction was now very promising. At present four colleges have chairs covering the science of heating and ventilation and courses are being formulated in several other colleges. He looked forward to see the time when a heating engineer would be consulted for residence equipment, as well as for larger installations.

Charles A. Fuller, who was then called on, expressed his gratification at the success of the school as reflected in the large attendance at the dinner. He stated that assurance had been given by the heating engineers' society that graduation from the school would count in considering a man's application for membership. As regards college courses, Mr. Fuller felt that a postgraduate course was not needed so much as the kind of instruction given by his school.

James A. Donnelly told of his long interest in the project that finally took form in the class conducted by Mr. Fuller. He had been an advocate of such a course for many years in discussing the subject at meetings of the heating engineers' society.

C. W. Obert, the new secretary of the American Society of Heating and Ventilating Engineers, was called on for a few words and he responded by expressing his pleasure at getting in closer touch with the heating fraternity through his new duties.

A. D. Hoxie, who was the last speaker, stated that an alumni association of members of the class would be formed March 27, and a permanent organization effected.

M. J. Sage was the toastmaster and before the serious speechmaking began the guests were treated to one of Jack Armour's bursts of oratory that more than prepared the way for the remainder of the programme.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HEATING—

Electric Heating; Its Present Position and Future Development. George Wilkinson. Abstract of paper before Inst. of Elec. Engrs., at Edinburgh. Ills. Also discussion. 2,500 w. Eln.—Dec. 24, 1915. Advantages of thermostatically controlled heaters. 40c.

LIGHT AND HEAT—

Modern Systems of Independent Lighting and Heating. Ills. 1,800 w. Nt.—Jan. 6, 1916. Oil, oil gas, and petrol-air gas systems. 40c.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

New State Association in Maine.

An association of master steam and hot water fitters was formed in Portland, Me., February 25, which, it is hoped, may be developed into a State association. At the organization meeting in Portland, most of the heating contractors of that city were present. The organization will be affiliated with the National Association of Master Steam and Hot Water Fitters. Officers were elected as follows; President, Arthur B. Fels; vice president, Arthur H. Moulton; treasurer, E. A. Wheeler; secretary, F. A. Davis. A committee was also appointed to draw up a set of by-laws. The following were present at the meeting: Fred E. Wheeler, Arthur H. Moulton, Christopher Madsen, G. F. Scribner, Arthur L. Knight, M. C. Hutchinson, W. R. Sawyer, Freeman Palmer, Myles O'Sullivan, Arthur B. Fels, Charles J. Tilton, Carl B. Brackett, Virgil L. Watson, W. W. Johnson, William E. Allen, H. F. Stuart, Fred Z. Butterfield, George H. Stevenson, James Boyman, Frank A. Davis, Iver H.

Iverson, E. A. Wheeler, all of Portland and vicinity; E. W. Goss, of Lewiston and T. W. Kerrigan, of Lewiston.

Organization of Master Fitters in Richmond, Va.

Master steam and hot water fitters in Richmond, Va., have effected an organization, with James E. Philips as president and Garret Boehling as secretary. Among the members of the new association are the Richmond Engineering Co., Pemberton & Benson, John E. Rose Co., Howard M. Delaney, the Carle-Boehling Co., James E. Philips & Son, McNichol & McMahon, Terrell E. Beckner, Pemberton & Benson and William Sikkelee.

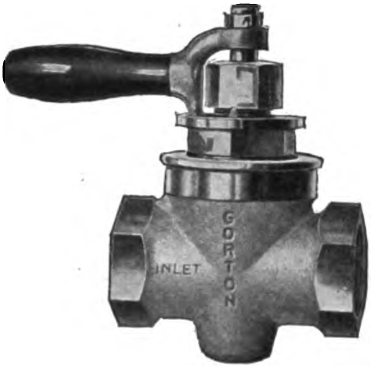
NEW DEVICES

A Quarter-Turn Packless Radiator Valve.

A valve that is described as easier to close than it is to open a window has lately been brought out by the Gorton & Lidgerwood Co., 97 Liberty Street, New York. It is known as the Gorton quarter-turn packless valve. A quarter turn of the handle in either direction opens or closes the valve. It is not necessary to stoop down to turn the handle. A touch of the foot is all that is required.

A number of unique features distinguish this valve which is made of steam metal of heavy pattern. It is not only packless, but all parts are interchangeable. The inside of the valve is cone-shaped, accurately turned to receive a cone-shaped disc, in which is a full-sized straightway opening. A quarter turn of this disc in either direction, as stated, opens or closes the valve. The disc seats itself upon the inner surface of the valve body and is held in place by a bronze spring, so that neither grit or dirt can come in contact with the valve seat. The disc and valve stem are connected by a loose joint which makes it impossible to throw the disc out of its seat.

GORTON PACKLESS RADIATOR VALVE.



VIEW SHOWING CONE-SHAPED CONSTRUCTION OF GORTON PACKLESS RADIATOR VALVE.

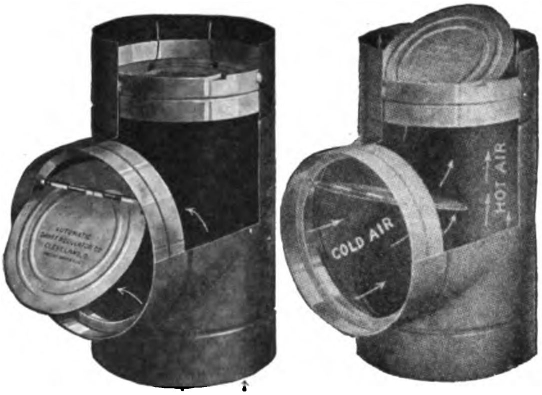
The disc is made of a mineral composition that is not affected by high steam temperatures, or by hot or cold water. In use it has been found not to stick or corrode, being apparently as indestuctible as the valve body itself.

The full size, straightway opening through the valve provides an unrestricted and easy flow of steam and a rapid return of the water from the radiator. This feature, it is stated, makes it possible to use a valve one size smaller than if it were the ordinary radiator valve. The valve is made in both the radiator and straightway patterns for all systems of steam, vapor, vacuum and hot water heating and the manufacturers emphasize the high grade of material and workmanship used in its construction.

New Type of Automatic Draft Control.

An interesting solution of the matter of draft control for use especially with fuel gas appliances, is an automatic draft regulator which has been brought out by the Lezius Automatic Draft Regulator Co., Cleveland, O. This device consists of a flue pipe tee made in various sizes, free and open at the bottom, and having a delicately-weighted aluminum gate or flutter valve fitted in the top or outlet; also a second gate or flutter valve without weight swung from a hinge in the tee. If there is little or no draft in the chimney, the outlet flutter remains open and the tee flutter closed. If the draft is small, the tee flutter inclines slighty; as the draft increases, the tee flutter inclines more, and when the draft becomes excessive, the gate is drawn inward to a perpendicular position, partially closing the area of the flue pipe and drawing a great proportion of the air from the room rather than the heat of the chimney, thus lowering the chimney temperature as well.

A great saving of fuel, it is stated, is possible with these regulators because of their being self-acting, depending upon the velocity of draft. Where down-draft occurs, the top or outlet flutter valve closes instantly. In that case the products of combustion momentarily escape into the room through the tee flutter, which then opens outwardly.



NEW AUTOMATIC DRAFT REGULATOR.

Should mortar, bricks or soot fall in the chimney and obstruct the flue opening, if there is no regulator or outlet of some kind for the products of combustion to escape, the flame would be smothered and gas escape unlighted through the burner. This would also happen if a down-draft should blow out or smother the flame. When such things occur, with draft regulators installed, the flame remains lighted and the escape of the products of combustion into the room serves as an indication of flue trouble.

Another function which, it is stated, is performed by this device is in connection with the ventilation of a kitchen with a gas range. Fitted high on the flue pipe leading from a gas range, the draft usually is great enough to draw air through the tee flutter, so that smoke and steam from the cooking on the top burners is carried up the chimney.

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Ric-Wil Underground Pipe Covering Co., Cleveland, O., manufacturers of the Ric-Wil tile underground pipe conduit, has changed its name to the Ric-Wil Co.

New Publications.

MINE VENTILATION STOPPINGS, WITH ESPECIAL REFERENCE TO COAL MINES IN ILLINOIS, is the title of Bulletin 99, recently issued by the United States Bureau of Mines. The author is R. Y. Williams. The author states that one of the most obvious conclusions from the inspection of several hundred stoppings is that the efficiency of a mine stopping to prevent the leakage of air depends more on the care with which the points are made than on the material that is used in construction. Some concrete stoppings were found to leak large quantities of air, because they were not set into the rib, and new tongue-and-groove stoppings were tight when carefully constructed. A protest is being made against high velocities in the ventilating currents in coal mines. Among other things, it was brought out that the weight of fine dust that is in suspension in the mine air varies approximately as the cube of the velocity of the ventilating current. This relation, states the report, has been established by W. H. Carrier, chief engineer of the Buffalo Forge Company, in experiments to determine the weight of material which can be handled by velocities above critical speed. The greater the velocity of the air, therefore, the larger will be the amount of fine coal dust that will be in suspension and deposited evenly along the entry way to assist in the propagation of an explosion throughout the mine.

GRAPHIC STUDIES IN ULTIMATE ANALYSIS OF COALS, by Oliver C. Ralston, has been published by the Bureau of Mines, Department of the Interior as Technical Paper 93. The paper presents the results of a study of the most reliable published analyses of coal. The analyses are studied from several different angles. The method of plotting used has served to reveal certain facts and laws that have not been suspected, as well as showing graphically much information that has been expressed in extensive tables of figures and in long statements that have been difficult of interpretation.

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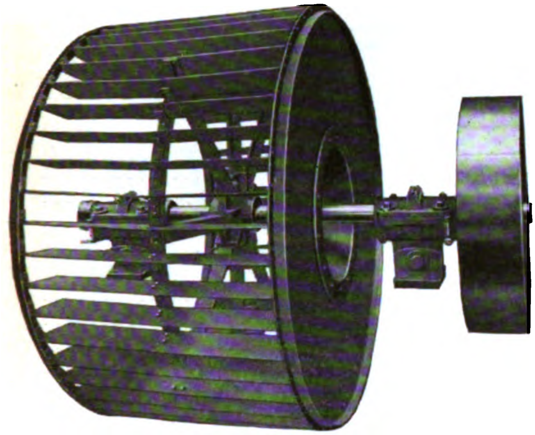
Trade Literature.

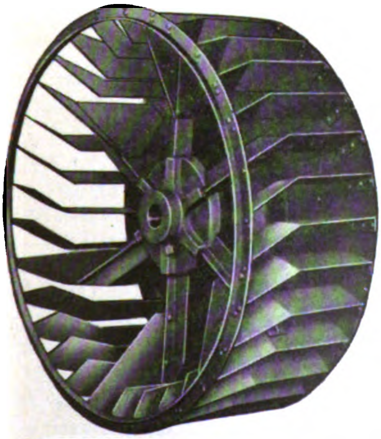
GARDEN CITY FAN COMPANY'S GENERAL CATALOGUE No. 160, for 1916, has been issued, covering this company's important line of cycloidal fans and blowers, Garden City fans and blowers, hot blast heating apparatus, induced and forced draft apparatus, air washers and conditioners, and vacuum blowers. The fact that the products represent an experience of 35 years in the fan and blower business is mentioned as an indication of their character and quality. The company's cycloidal multivane fans are given first place in the catalogue, being described as different from all other fans, the vanes or blades being set at



CYCLOIDAL MULTIVANE FAN WHEEL.

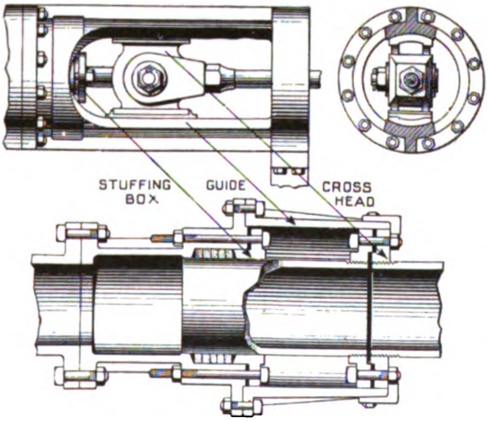
an angle to the shaft. They are regularly built in all types and styles, with any number of vanes. It is stated that severe and exhaustive tests at the hands of pneumatic experts have proven that, as compared with any fan using blades fixed parallel with the shaft, the cycloidal will deliver more air with less power and at a lower speed. The company also emphasizes the mechanical construction of its fans, all shafts, for instance, being ground and of polished carbon steel. Many detailed views show the construction of the cycloidal fan, to which are added the necessary data. The catalogue concludes with several pages of miscellaneous engineering data. Size 6 x 9 in. Pp. 143.

Brass and Copper, covering the Star brand sold by the U. T. Hungerford Brass & Copper Co., 80 Lafayette St., New York, is the title of a new catalogue, consisting of over 400 pages, in cloth covers. The contents are classified in separate departments, thereby providing the trade with a concise price list, together with lists showing material aggregating over 5,000,000 lbs. carried in stock ready for shipment.



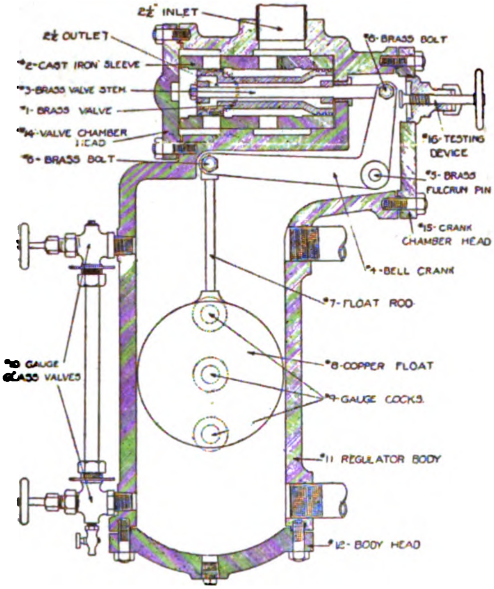
SINGLE INLET TYPE, CYCLOIDAL MULTI-BLADE FAN WHEEL.

The Ross "Crosshead-Guided" Expansion Joint, described as a permanent, leakless, long-travel expansion joint for high and low pressure steam, oil, gas and water piping, is featured in a new catalogue issued by the Ross Heater & Mfg. Co., Buffalo, N. Y. This expansion joint was designed by S. C. Ross, formerly with the Alberger Heater Co., of Buffalo. It has been under observation in installations for the past five years on high and low pressure steam and on hot water lines, in sizes up to 14-in., and it is stated that not one of the forty fittings on this job have ever had a ring of new packing put in it or has had a gland pulled up. The new plant of the Remington Arms & Ammunition Co., at Bridgeport, Conn., has about 40 of these fittings in sizes from 4-in. up to and including 16-in., and the company states that it has just shipped three 16 in. cast-steel fittings which will operate on 180 lbs. steam and 300° superheat. The catalogue describes the fitting in detail, its mechanical principle being likened to the piston rod, stuffing box, crosshead and guides of the ordinary steam engine. Size 6 x 9 in. Pp. 16.



COMPARISON OF MECHANICAL PRINCIPLE OF THE ROSS EXPANSION JOINT AND PISTON ROD, STUFFING BOX, GIRDERS AND CROSS HEAD OF STEAM ENGINE.

Ray's Continuous Feed-Water Regulator, described as the final word in feed-water regulation, and the only one-piece continuous feed-water regulator on the market, is brought to the attention of the trade in a new circular published by the Ray Mfg. Co., Louisville, Ky. This device, it will be noted, has the float chamber, water column and feed valve all combined in one piece. According to tests as described in the circular, made with a steam flow meter, measuring the output of a boiler, it was shown that the Ray regulator will give a continuous feed of water to the boiler at the



THE RAY CONTINUOUS FEED WATER REGULATOR.

exact ratio it is being evaporated. No adjustment, it is stated, is necessary, or tinkering with expansion tubes, diaphragm or other delicate devices, nor, it is added, will cold or heat affect it.

THE PIPOGRAPH, a unique calculator for figuring the net cost per foot of pipe, either black or galvanized iron or steel, has been brought out by the Pipograph Co., 51 Cliff Street. The Pipograph measures 9 in. in diameter and has a superimposed disc which may be turned to the point desired. All pipe discounts from 35% off the list to 81% on all sizes from ⅛-in. to 4-in. pipe are shown. To get the net cost per foot of pipe the upper disc is turned until the slot is opposite the discount desired. The price for each size pipe may then be read direct. The Pipograph is mounted on cardboard and is printed in two colors. The hole in the center clasp makes it easy to hang up for quick reference. Copies of the Pipograph may be obtained from the book department of THE HEATING AND VENTILATING MAGAZINE on receipt of the price, $1.00.

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New Magazine-Feed Boiler.

A recent addition to the Bernhard line of boilers, made by the Kanawha Mfg. Co., Charlestown, W. Va., is a magazine-feed boiler, which is designed to burn all kinds of coal, from the cheapest grades of bituminous coal to all grades of anthracite in sizes up to stove coal. The boiler was designed by J. B. Bernhard, who has placed many successful designs on the market.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MAY, 1916

Passenger Car Steam Heating Plant at Atlantic City, N.J.

By CHARLES A. BINGAMAN,

Mechanical Engineer, Philadelphia and Reading Railway Co.

In conveying live steam over considerable distances, overhead steam lines are in nearly every case preferable to underground systems, since almost perfect insulation can be provided. This was demonstrated the past winter in one instance where the writer was obliged to install a shop heating supply line from a power house to a large car shop. This line was carried on poles, overhead, for a distance of about 500 ft., entirely exposed to the weather. During a sleet storm, the line was covered with a sheet of ice, and icicles 10 in. long were suspended from pipe covering for a period of two days, while line was passing steam at 100 lbs. pressure.

There are cases, however, where it is not possible to place steam lines overhead, and recourse must be had to one of several underground systems, as follows:

TYPES OF UNDERGROUND SYSTEMS.

(a) Steam line encased in tile pipe, underdrained.

(b) Steam line encased in cast-iron water pipe.

(c) Steam line encased in concrete ducts, underdrained.

(d) Steam line encased in wood box trunking.

(e) Steam line encased in wood stave pipe casings, providing insulation and waterproofing at same time.

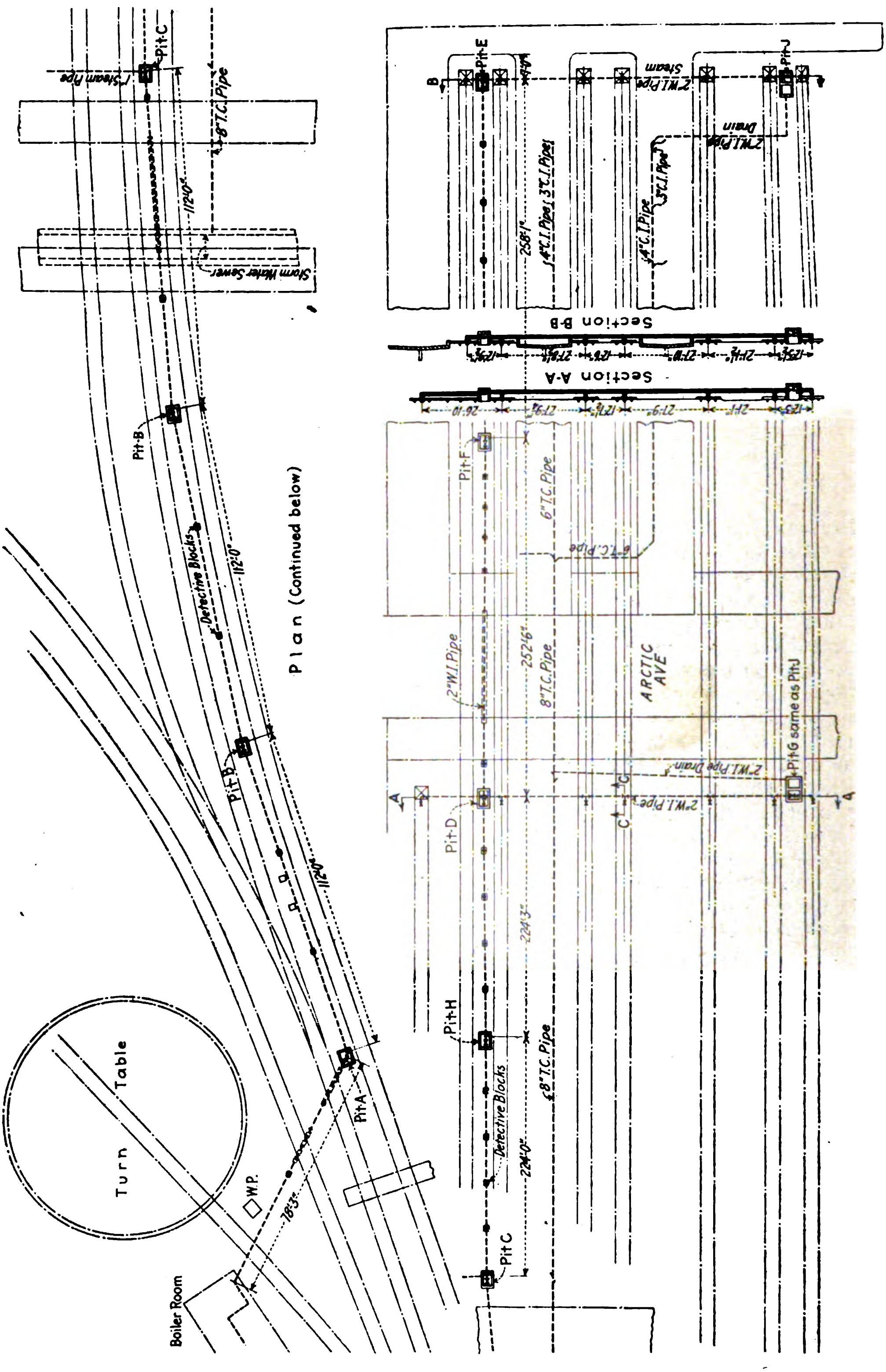
The selection of the best method of insulation for underground steam lines depends somewhat on the conditions to be met in each case and, in the writer's opinion, no so-called "best" method can be adopted on snap judgment for any case without danger of overlooking certain important features which may be peculiar to the proposed installation, and which may require special designs to cover same.

The least desirable methods, however, would seem to be those of encasing steam lines in ordinary wood box trunking or in cast-iron pipe; because, in the first case, a water-tight job cannot be obtained, and any insulation on pipe which might be used in connection with box trunking would not be effective when water-soaked; in the second case, there is the disadvantage of being unable to locate leaks in steam line, or to make repairs without a great deal of trouble and expense, to say nothing of delay in completing repairs and getting the line back into service.

THE PROBLEM AT ATLANTIC CITY.

The problem confronting the Atlantic City Railroad at its Atlantic City terminal, in providing a successful heating system for heating passenger cars standing at the station, was complicated by the following conditions:

1. The boiler plant was approximately 1,400 ft. beyond the station platform, at which cars were coupled to heating lines. Steam from the boiler plant passed to the heating lines through Foster steam pressure regulators. An overhead line could not be used on account of hav-



ARRANGEMENT OF PASSENGER CAR STEAM HEATING PLANT AT ATLANTIC CITY.

ing to cross a number of yard tracks and two city streets.

2. Yard tracks are laid on cinder fill, covering a sandy soil, and the underground steam line, which was finally decided upon, passed under several tracks, thence close to the ends of ties along one of the curved main tracks, it being found impossible to place the pipe line in the center between two running tracks, on account of switch target bases, etc.

3. It was necessary to adopt some form of insulation which was both heat-proof and water-proof, since during heavy rains the entire yard is covered with water to the top of the rails, and during storm tides has been covered with water to a depth of 14 ft.

It was also necessary to have insulation of such a character that it could be brought to the ground ready for rapid laying, without the necessity for cutting and fitting in the field, so as not to hold the pipe trench open for any great length of time, because of the danger of the caving in of tracks, due to heavy trains passing over tracks close to trench.

The above reasons made the use of an underdrained system of concrete ducts or tile ducts inadvisable, since concrete form work and seasoning of concrete would have required the trench to be open a considerable length of time, and the fact that the steam line was required to be laid at a shallow depth, due to obstructions in the form of water pipes. sewers, etc., in city streets, prohibited the use of tile casing, on account of danger of breakage, due to vibration of heavy trains and locomotives.

4. Special protection to insulation and steam lines was required, where the line crossed under yard tracks and under surface of city streets having heavy motor-truck traffic.

5. It was necessary to provide means for the detection of leaks in the steam line, and to arrange to make repairs to the line without great expense and delay.

WOOD PIPE CASING FOUND TO MEET REQUIREMENTS.

After consideration of a number of proposed installations, wood pipe casing, of the Standard Wood Pipe Company make, was finally decided upon as offering the best chances for success, and as meeting all the special requirements of the case. Best-grade white pine was decided upon as the material for the wood casing, since the alternate wet and dry ground conditions would be better resisted by white pine than by other woods.

DESCRIPTION OF INSTALLATION.

By noting the illustrations which are taken from working drawings a fair idea of the installation may be obtained.

All pipe and casing were necessarily laid in straight lines, provision being made at concrete expansion-joint pits for changes in the direction of the line, due to track curvature. No flanges were used on pipe passing through wood casing, all pipe being screwed together, using flanges only where attaching lines to expansion joints and anchorage fittings.

Steam pressure tests, at 80 lbs. to 100 lbs. per square inch, were made, testing every 40 ft. of line as made up and screwed on to the line, and before driving on the wood pipe casing.

Pipe guides, made in halves, of cast-iron were wired to the steam pipe, using two guides to each pipe length, to insure the steam line being centrally located in the bore of the wood pipe casing. Litharge and glycerin was used as pipe joint paste, to insure a tight, permanent job.

All ends of wood casing at the concrete pits were made to extend 2 in. beyond the inside face of the pit wall, and the wood casing was made with tapered chambered ends, to receive special cast-iron flanges driven into the wood casing ends and securely held in place by lag screws and wrought-iron keepers. These cast-iron flanges were designed to form a water seal for the wood casing and around the wrought-iron steam pipe, packing glands being provided with these flanges to provide for the free expansion of the steam lines.

It was found upon actual test under 80 lbs. steam pressure that ample expansion movement had been provided for, as noted on the plan of installation, at each expansion joint pit.

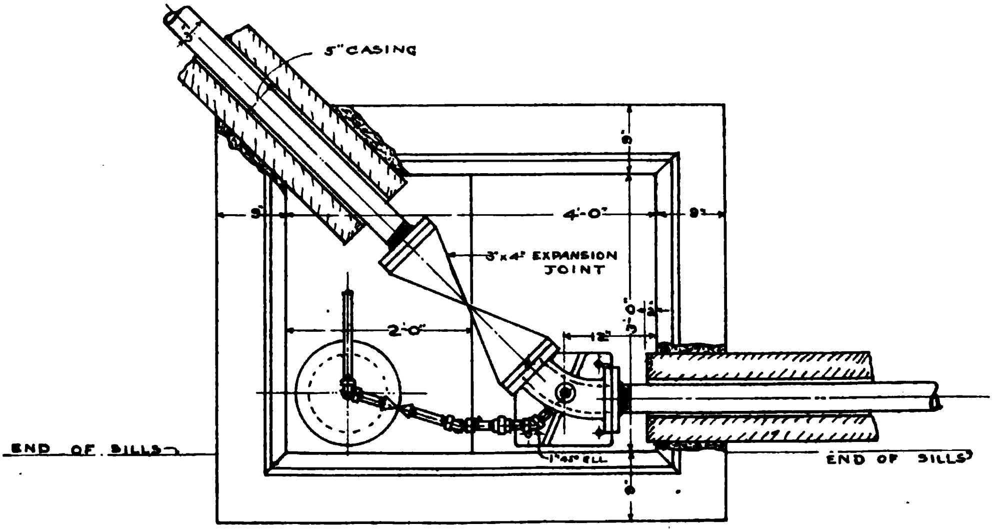
Detective blocks were introduced at regular intervals of 40 ft. to 60 ft. throughout the wood casing installation. these blocks being made in halves, cut on a horizontal center line, and secured together by ½-in. round iron bands, with nuts. A 1¼-in. gas pipe was screwed into the top half of the detective blocks, these pipes being extended to the surface of the ground, with a loosely-screwed pipe cap on the end of the pipe, by the removal of which the location of a leak in the steam line can easily be detected.

Detective blocks also make it possible to make repairs to the steam line more easily, since, by disconnecting the line at the expansion pits and removing a detective block, a section of pipe and casing can be removed and replaced without disturbing the remainder of the line.

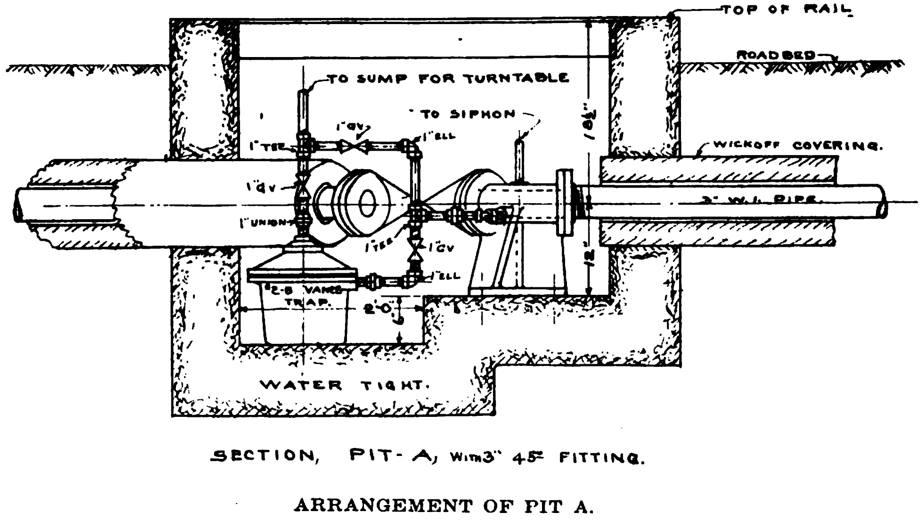
Special provision was made at the top of the riser pipe casings to render same water-tight, by means of a running straight thread on the riser pipe, and the use of a screwed gland, with a taper fit into the chamber of the wood casing riser, this being screwed tight into the chamber, when the riser pipe was heated and expanded.

All drainage of steam lines was taken care of by means of automatic steam traps, arranging for gravity discharge from hot water sumps to sewer connections, so as not to have any possibility of steam pressure in the sewer lines.

When making up the wood casing at the factory, the lines were carefully laid out, as shown on the working plans, and each piece of piping or fitting casing was



PLAN PIT-A.



SECTION, PIT-A, With 3" 45° FITTING.

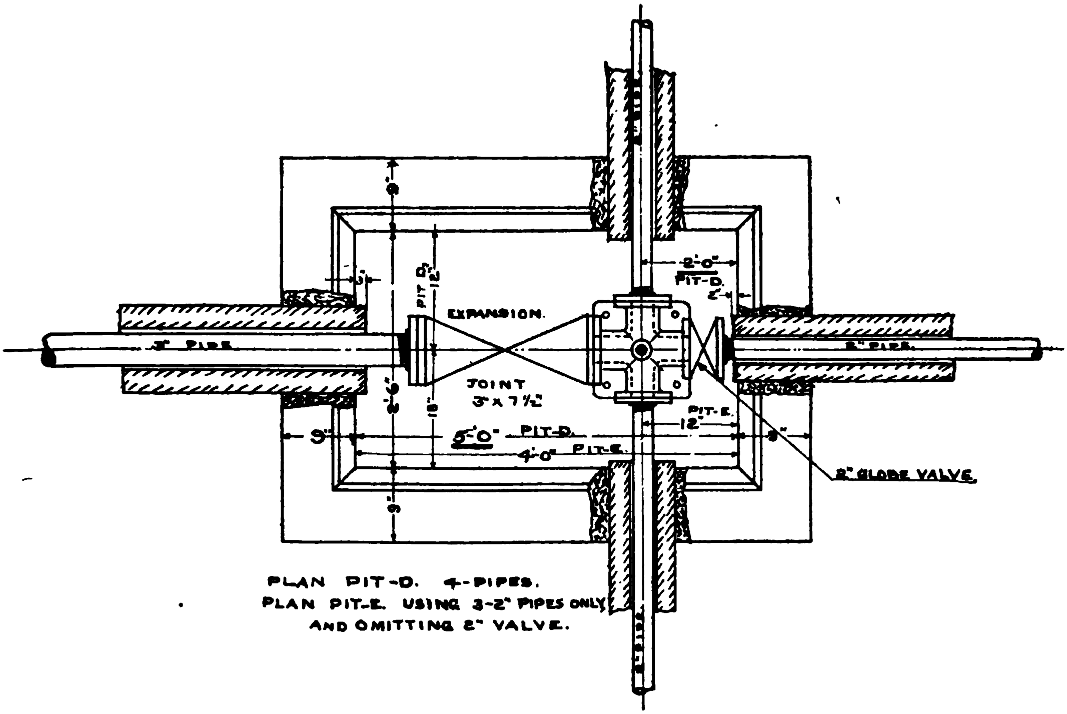
ARRANGEMENT OF PIT A.

tagged and numbered to agree with its position as shown on the drawing. The value of this was found when making the installation, since there was no confusion in assembling and placing the material, and the work was installed very rapidly, without any cutting and fitting in the field.

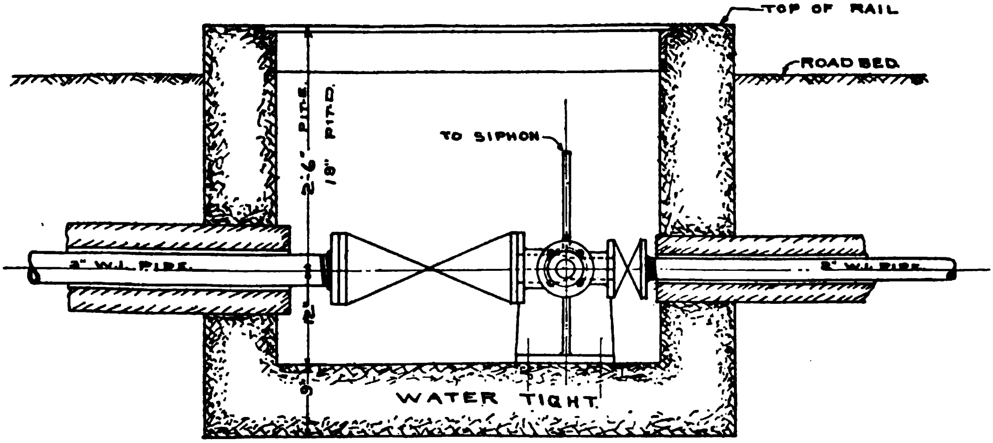
SPECIFICATIONS FOR THE WOOD CASING.

Since the specifications for the wood casing used in this installation may prove of some interest, a condensed form of same is given herewith, as follows:

(1) Wood casing to be made of good, sound, well-seasoned, white pine, in



PLAN PIT-D. 4-PIPES.
PLAN PIT-E. USING 3-2" PIPES ONLY
AND OMITTING 2" VALVE.



SECTION OF PIT-D.
" " PIT-E, OMITTING 2" VALVE.
BLANK 3" END IN PIT-E.

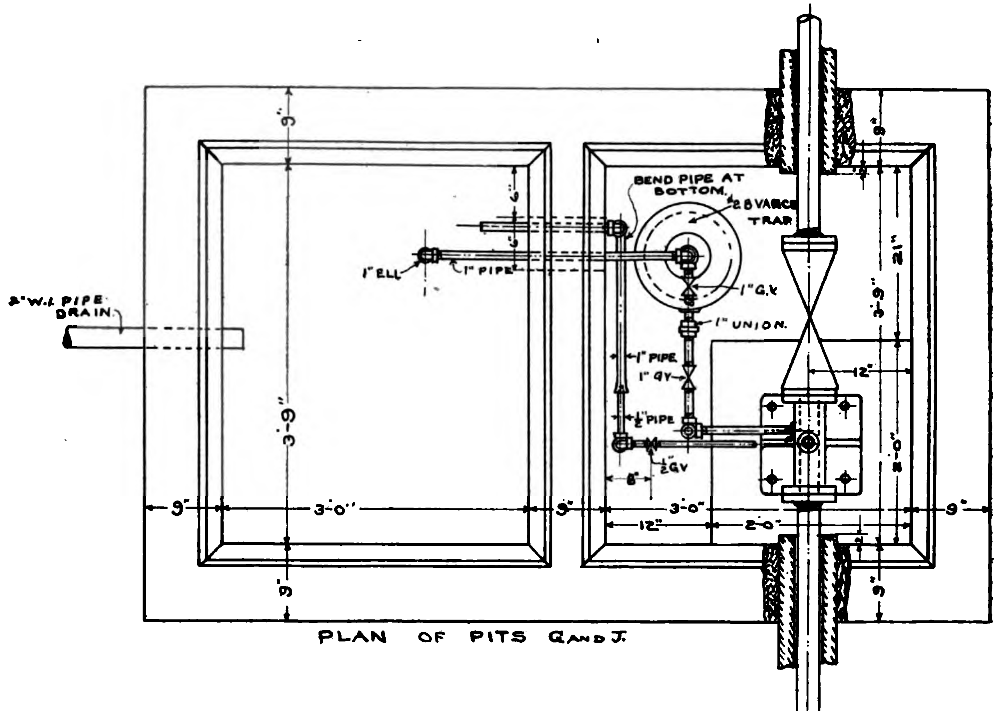
ARRANGEMENT OF PITS D AND E.

lengths of 12 ft., making such odd lengths as may be required to make up necessary line lengths to fit conditions shown on working plans.

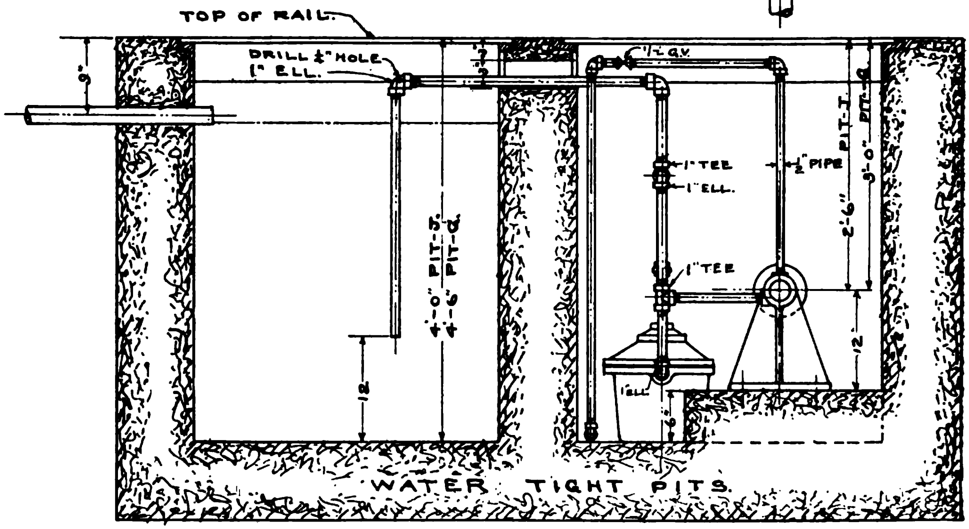
(2) Casing to be lined with heavy tin, with clear bore dimensions of 5 in. for casing used on 3-in. w.i. pipe, and 4 in. for casing used on 2-in and 1½-in. pipe.

(3) Casing to be made of staves, having a uniform thickness of 4 in., planed on both sides to circle corresponding to outside and inside diameter of casing. Edges of staves to be radial, with beads left on one edge and grooves on the other edge, to fit staves together.

(4) Casing to be banded spirally with



PLAN OF PITS G AND J.



SECTION OF PITS G AND J

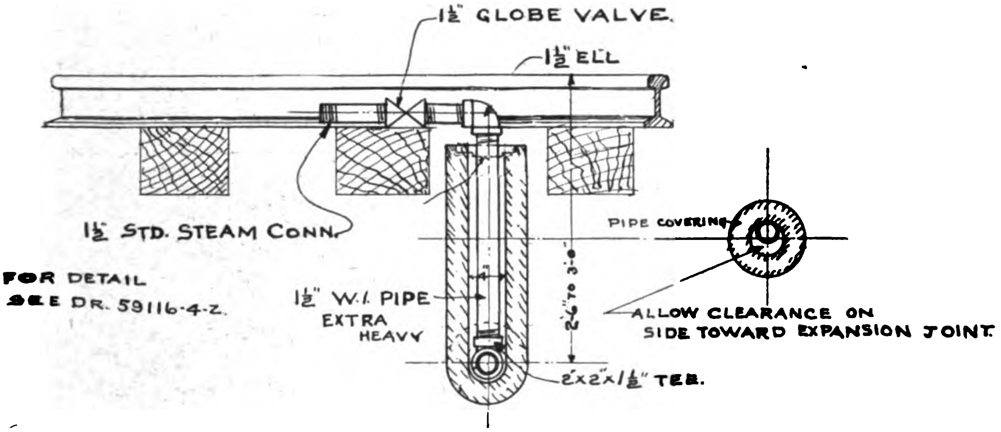
ARRANGEMENT OF PITS G AND J.

heavy steel wire, wound under tension sufficient to cut wire into wood staves and insure tight casing. Spacing of wire spirals to be not over 4 in. and wire banding to be stapled to wood staves, using staple every 9 in. along wire, measuring on spiral along circumference of casing.

(5) Casing to have a waterproof coating of hot Hydrolene after wire banding is applied, and to be then rolled in sawdust, as a protecting coating.

(6) Chambers and tenons to be moderately tight drive fit, to insure tight joints when line is made up in trenches.

(7) All ends of casings projecting into concrete pits or ends of riser casings to have tapered chamber to received c. i. water seal flange glands. The tapered chamber ends of all casings to have a protecting tension band of ½ in. round iron, with nuts, to prevent opening of staves under gland pressure.


1½" GLOBE VALVE.
1½" ELL
1½ STD. STEAM CONN.
FOR DETAIL SEE DR. 59116-4-Z.
1½" W.I. PIPE EXTRA HEAVY
PIPE COVERING
2'6" TO 3'0"
ALLOW CLEARANCE ON SIDE TOWARD EXPANSION JOINT.
2"x2"x1½" TEE.

RISER SECTION ON C-C BETWEEN PITS D AND G.

(8) Tee blocks, all blocks, and detective blocks to be made of blocks of well-seasoned white pine, free from knots. Blocks to be cut from square timbers, made in halves, tin lined, split on horizontal center line.

To be held together with ½-in. round iron bands, with nuts and special lugs, using a band at each end of block, which is to be turned circular to receive band.

Blocks to be not less than 3 in. thick at least dimension, and to be chambered or tenoned, as required, to make up lines as shown on working plans.

Blocks to be coated with hot Hydrolene and sawdust, as specified for regular pipe casing.

(9) All tenons or chambered ends to be treated with creosote at factory before shipment is made.

(10) Detailed statement of shipment, giving piece number, to accompany shipment of material, and each piece to be tagged, for identification with working plans, to facilitate work in field.

CONSTRUCTION OF EXPANSION PITS.

Regarding the concrete expansion pits, sump pits, etc., it should be noted that these pits were constructed of 1½-in. concrete with Trus-Con integral waterproofing.

Each pit was equipped with a steam siphon, with a controlling valve at the top of the pit, to drain same after heavy rains or high tides had subsided.

RESULTS OF TEST OF LINE.

The actual test of this line showed the following results:

1. With 80 lbs. pressure entering the steam heating line at the boiler plant, and all outlets closed at the station platform end of the line, the drop in pressure between the two ends of the line was only 5 lbs.
2. With an outside temperature of 30° F. and wind about 12 miles per hour, 31 passenger cars were comfortably heated on the test run.
3. The line has at no time given any trouble, and steam condensation in line is at a minimum, as may be noted from the trap discharge at the sump wells.

This shows that the line is almost perfectly insulated, and that dry steam is delivered to the cars at the end of the system.

The line has now been in service for nearly three months and has given perfect satisfaction.

The work was designed and installed by the Motive Power Department of the Philadelphia & Reading Railway Company, under the supervision of Charles A. Bingaman, mechanical engineer.

Tests of a Magazine Steam Heater

By E. H. Lockwood,

Assistant Professor of Mechanical Engineering, Sheffield Scientific School, Yale University.

Numerous fuel tests have been made at the Mason Laboratory of Mechanical Engineering as a part of the study of combustion in residence heating boilers, carried out under the general direction of Dr. L. P. Breckenridge, professor of mechanical engineering. In response to requests, the following brief summary is given of a portion of the work relating to magazine heaters.

DESCRIPTION OF THE HEATER TESTED.

The principal feature of the heater here referred to is a reservoir or magazine from which the fuel feeds down over the grates by gravity. The successful action of the furnace depends on the design of both the reservoir and the grates. in this heater* the grates are inclined like the sides of a flat letter A, placed symmetrically under the magazine, all arranged as shown in Fig. 1.

The fire is started on the grates, and notwithstanding the stored fuel above, the fire shows no tendency to enter the magazine. The gases pass through short tubes to the front, thence through tubes to the rear, providing effective heating surface.

The fuel best adapted to magazine feed is a small size anthracite coal, such as No. 1 buckwheat. The larger sizes, pea and chestnut, also broken coke, can be used in emergencies, but the small fuel is preferable on account of its cheapness and better feeding qualities.

FIRING PERIOD.

The entire contents of the magazine can be used up without any attention either to shake the grates or to spread the coal. The following table gives the principal data regarding the firing period of a small-size heater:

Maker's rating	700 sq. ft.
Water heating surface	123 sq. ft.
Grate surface, projected area	4.7 sq. ft.
Magazine capacity at one firing, buckwheat coal	350 lbs.
Rate of combustion per hour at rating	20 lbs.
Firing period at rating	17.5 hrs.
Firing period at 150% rating	11.5 hrs.

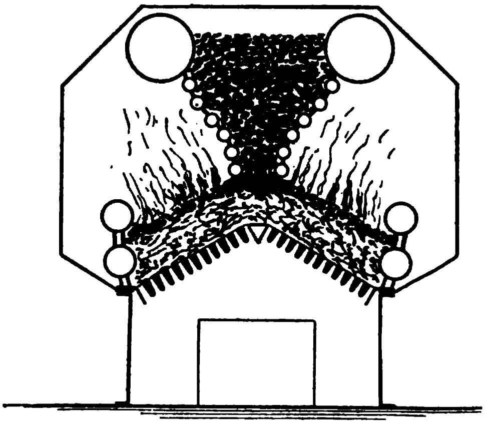


FIG. 1:—DESIGN OF HEATER USED IN TEST.

Numerous tests, made with coal bought in New Haven, have demonstrated that the fuel will feed over the entire grate surface, maintaining a steady fire without danger of burning out or clinkering for the periods indicated above. To secure these results it is necessary to clean the fire thoroughly with the magazine empty before firing new fuel. If the ashes are partially removed by simply shaking the grates with fuel in the magazine, the feed is liable to be interrupted by clinkers, requiring assistance to bring down fresh fuel from the magazine. It is necessary, therefore, for the attendant to learn the proper method of cleaning the fire to secure perfect feed over long periods.

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*Made by the Spencer Heater Company, Scranton, Pa.

ECONOMIC PERFORMANCE.

The boiler efficiency of the magazine heater just described is somewhat less than the efficiency found in flat-grate heaters of the best makes. This conclusion has not yet been confirmed by tests of other magazine heaters and possibly it may be true only of this particular unit. Our tests have shown uniformly a slightly lower efficiency, in spite of a boiler with ample heating surface, with a fire covering the whole grate all the time and a low flue temperature.

These facts indicate a lower furnace temperature and hence necessarily a lower efficiency. Clinkers are an index of high temperature, and their absence in the magazine furnace is a fair indication regarding temperature conditions. The loss of efficiency in the magazine heater may be considered as the price paid for the convenience of long-firing periods without attendance.

The foregoing paragraph gives an erroneous idea of the real efficiency of the magazine heater, considered from the standpoint of cost of producing heat. The loss of efficiency in burning coal, assuming this loss to exist, is offset many times over by the ability of the magazine heater to burn the small sizes of fuel, whose cost is approximately one-half that of the larger sizes. The magazine heater can, therefore, claim a good showing on two important points, convenience and economy.

BOILER RATING.

The boiler referred to in these tests was rated at 700 sq. ft., and this capacity was secured when burning only 4¼ lbs. of coal per square foot of grate area per hour. With good chimney draft it was possible to double this rate of combustion while the boiler efficiency remained

SAMPLE TEST OF MAGAZINE STEAM HEATER.

1.	Date of test	December 28, 1915
2.	Duration of test	26.15 hrs.
3.	Water heating surface	123 sq. ft.
4.	Grate area, projected	4.7 sq. ft.
5.	Kind of fuel	Yard pea, equivalent to No. 1 buckwheat
6.	Weight of coal fired (two firings)	693 lbs.
7.	Average firing period	13 hrs.
8	Ash and refuse in coal	15.4%
8a.	Ash in coal by analysis	9.87%
9.	Total weight of water fed to boiler	6080 lbs.
10.	Moisture in steam, by separator	0.4 of 1%
	Hourly Quantities.	
11.	Coal burned per square foot of grate per hour	5.47 lbs.
12.	Equivalent evaporation per hour from and at 212° F.	240 lbs.
	Pressures and Temperatures.	
13.	Average steam pressure by gauge	5.5 lbs.
14.	Average temperature of feed water	185° F.
15.	Average temperature of flue gases	265° F.
16.	Average draft	0.11 in.
	Capacity.	
17.	Makers' Rated capacity	700 sq. ft.
18.	Boiler capacity during test	960 sq. ft.
19.	Per cent. of rating developed	137
	Economic Results and Éfficiency.	
20.	Water fed to boiler per pound coal as fired	8.78 lbs.
21.	Equivalent evaporation from and at 212° per hour per pound of dry coal	0.37 lbs.
22.	Calorific value of dry coal	13,800 B. T. U.
23.	Over-all efficiency, based on dry coal	66%

unchanged or even slightly better. If the rating of this boiler were increased 50% it would operate on a firing period of 12 hours with slightly increased economy of fuel.

The makers have erred in under-rating this magazine heater, being influenced perhaps by the practice of manufacturers of other types of heaters. Better results will be obtained by operating magazine heaters at higher rates of combustion, reducing first cost of installation, and, at the same time, increasing the fuel economy.

Test of Air Conditions in an Illinois School

WITH SUGGESTIONS FOR MAKING TESTS AND RECORDING RESULTS.

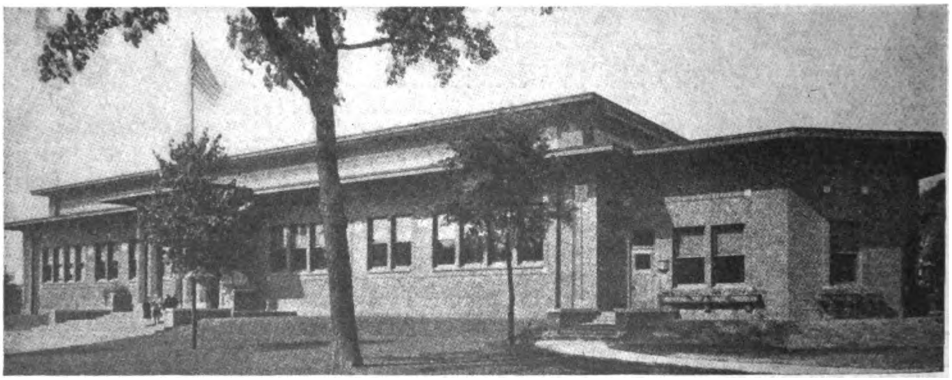
By E. V. Hill, M. D.

Ventilating Inspector in Charge, Division of Ventilation, Chicago Department of Health

Requests are frequently received by the Ventilation Division of the Chicago Health Department for tests of air conditions in schools, not only in Chicago, but in towns and cities of the surrounding country. In many instances these requests arise from conditions that, it is apparent, are far from satisfactory. It not infrequently happens, however, that the request comes from a school recently built and equipped with the best modern ventilating appliances. In these cases it occasionally happens that considerable feeling is engendered between the engineers and the teachers in such schools. The engineer feels that the plant he has designed should give satisfactory air conditions and that there is no just cause for complaint. The school teacher, on the other hand, frequently complains of the extremely unsatisfactory air conditions in the class room even with the constant operation of the mechanical equipment.

This situation has brought mechanical ventilation, in schools particularly, into more or less disrepute and causes many persons to advocate window ventilation as the more desirable. I am satisfied from the tests and observations made by this department that the responsibility for this condition of affairs must be placed, in a large measure, on the engineers who design and superintend the installation of these mechanical equipments, not always on account of poor design or careless work, but because of improper testing and adjustment of the installation after its completion.

There is another class of cases that occasion considerable difficulty and complaint, I refer to instances where the type of occupancy of certain rooms, or the use to which they were to be put, was not clearly understood by the ventilating engineer when the equipment was laid out; for example, rooms intended for office purposes, where a comparatively small amount of air was introduced, are sometimes turned into class rooms with very

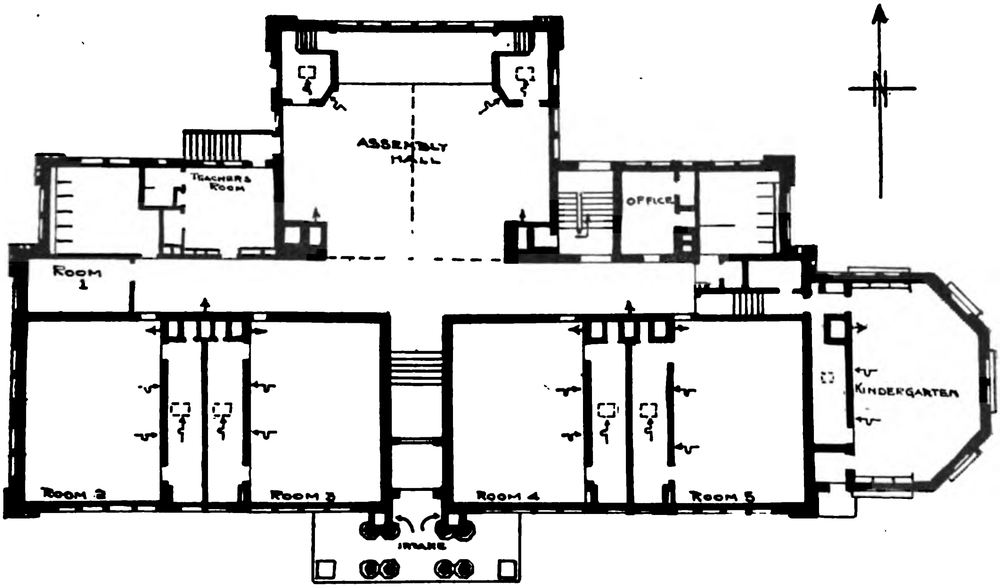


JOSEPH SEARS SCHOOL, KENILWORTH, ILL.

unsatisfactory results. These cases cannot be charged up to the engineer, but occasion considerable trouble.

WHY CLASS-ROOM VENTILATION IS OFTEN UNSATISFACTORY.

To properly ventilate a class-room requires an adequate air supply and the maintenance of a comfortable temperature. These two conditions are usually obtained and verified by tests, but to properly ventilate a class-room requires much more than this. It is essential that an air movement be maintained sufficient to remove the aerial envelope about the bodies of the occupants; a relative humidity of 35% to 50%, depending upon the temperature; a bacterial content not exceeding 10 colonies on a two-minute plate; a satisfactory CO_2 standard; a dust content not exceeding 100,000 particles per cubic centimeter as tested with the Aitken portable dust counter.



PLAN OF JOSEPH SEARS SCHOOL, KENILWORTH, ILL.

The air must also be free from odors and the distribution of the incoming air must be thorough and uniform. The room must also be free from objectionable drafts. The equipment should be so constructed that all parts of the ducts, fans, heaters, etc., are readily accessible for inspection and frequent cleaning. These additional requirements for the proper ventilation of a class-room are certainly of equal importance to the maintenance of an adequate air supply and a comfortable temperature, but they are not given proper consideration by the engineer in designing, and tests are not conducted after the installation of the apparatus to ascertain whether or not such requirements are being fulfilled. This is due to two causes: First, the average engineer does not have the necessary equipment and training for making the tests, and second, standards for these various requirements have not been heretofore definitely ascertained.

I believe it can be easily established that if the requirements just mentioned are met, either by a natural or mechanical system, there will be no complaints from the occupants regarding poor ventilation. Further, it is safe to assume that the air conditions will be productive of the best results from the standpoint of health. It is also evident that these requirements cannot be fulfilled by the use of windows in cold weather and a mechanical equipment must be used. It remains, therefore to see that the equipment meets, not two or three, but all of the requirements mentioned and that actual tests establish this fact. In making tests of this character during the past four years the department has never lost sight of the necessity of establishing comparative standards, and while it is evident that many of these so-called standards must vary under varying conditions, and while it is also true that continued investigations may make it necessary to modify some of them, still the adoption of such standards has proven of considerable value in carrying on this work, especially in comparing the results obtained from different observations.

FEATURES OF SEARS SCHOOL TEST.

The following report of a test made in the Joseph Sears School of Kenilworth, Ill., is not given as an illustration of poor ventilation design, as the results obtained, with certain exceptions noted, are entirely satisfactory. It illustrates the method of testing school ventilation and also brings out the fact previously mentioned, that rooms occupied otherwise than originally intended give rise to serious complaint. It also shows results of tests in class-rooms ventilated by means of a good mechanical equipment as compared with those where window ventilation is employed:

The building is located on spacious grounds. It is a one-story and basement structure with a very pleasing architectural effect. All the class rooms, with the exception of one devoted to arts and crafts, are located on the main floor and have ample floor space and window area per occupant. The exception noted is situated over two-thirds below grade and the window area is deficient. This deficiency is more important than it would be in other parts of the building, owing to the fact that no air is supplied this room by the mechanical equipment.

It should also be noted that room No. 1, which evidently was originally designed as a store room, has been converted into a class room and occupied as a kindergarten at the present time. There is no mechanical air supply in this room and proper lighting and ventilation by the window cannot be secured.

The toilet facilities are ample for the building; the fixtures are comparatively modern and maintained at a high point of efficiency; the floors and general condition of cleanliness throughout the building, both with regard to construction and maintenance, are all that could be desired.

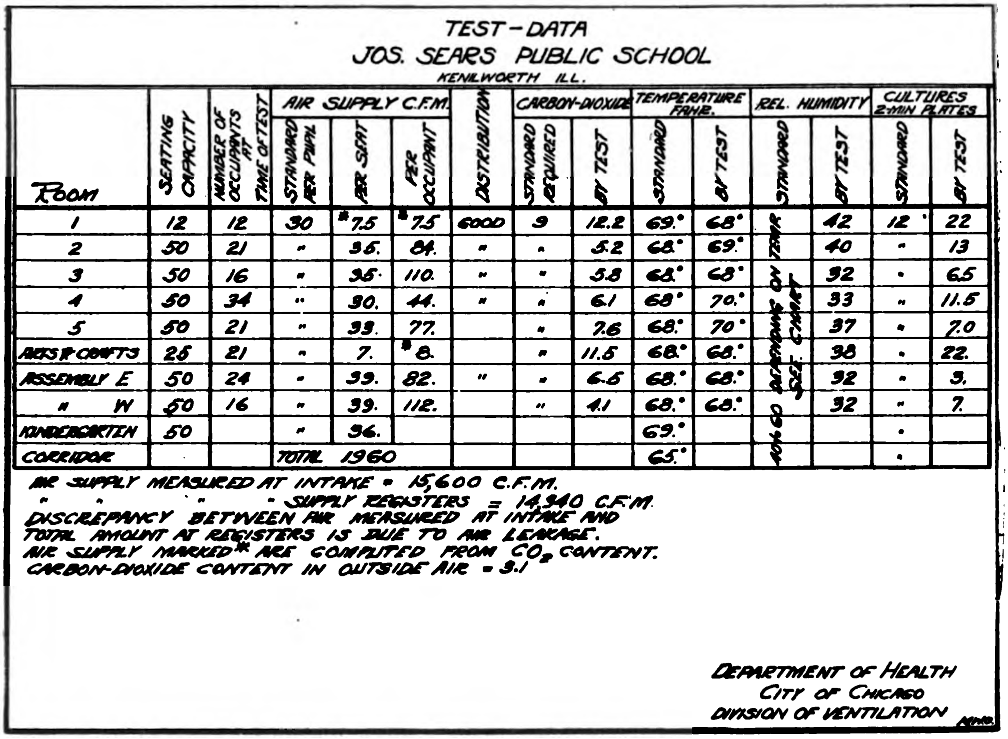
MECHANICAL EQUIPMENT.

With the exception of the toilet rooms, teachers' rooms and some others the building is heated and ventilated by a blast system. The air is brought in through intakes at the roof line, situated behind the columns at the entrance. The fan and tempering coils are located in the basement below the main entrance corridor. The tempering coils, consisting of three stacks of Vento heaters, with a by-pass damper beneath, are thermostatically controlled. The air is drawn through the coils into a double discharge, full-housed, belt-driven multivane fan, from which it is distributed to the various risers to the class rooms. The motor is 5 H.P., without speed control. In the upper portion of each riser is a re-heating coil thermostatically controlled from the room it supplies. The room is so designed that the air may be delivered at the floor line in warm or moderate weather without being re-heated. In cold weather the register at the floor line is closed and the one in the top of the riser opened so that the air is passed through the reheating coils before entering the room. The foul air from the class rooms is carried out beneath a space left between the blackboard and the floor in the cloak room and out through a ceiling grille by gravity.

No air washer is used in the equipment, but a humidifying device, consisting of perforated steam pipes provided with mufflers, is used. This humidifier is situated between the tempering coils and the fan inlet and is controlled by a humidostat located in the assembly room. The capacity of the fan at the speed operated is about 15,600 C.F.M. The boiler is a No. 12 Kewanee fire box of about 4,500 sq. ft. capacity.

SCOPE OF TESTS.

Investigations were made to determine the quantity, quality and distribution of air in the various class rooms. Anemometer readings were taken at the registers and checked by total air supply through the intakes. The distribution was determined by means of an ammonium-chloride test and also by samples of air taken and analyzed for carbon dioxide. Humidity and temperature observations were made and counts of bacterial



TEST-DATA
JOS. SEARS PUBLIC SCHOOL
KENILWORTH ILL.

ROOM	SEATING CAPACITY	NUMBER OF OCCUPANTS AT TIME OF TEST	AIR SUPPLY C.F.M.			DISTRIBUTION	CARBON-DIOXIDE		TEMPERATURE FAHR.		REL. HUMIDITY		CULTURES 2-MIN PLATES	
			STANDARD PER PUPIL	PER SEAT	PER OCCUPANT		STANDARD REQUIRED	BY TEST	STANDARD	BY TEST	STANDARD	BY TEST	STANDARD	BY TEST
1	12	12	30	*7.5	*7.5	GOOD	9	12.2	69.°	68.°	40 to 60 DEPENDING ON TEMP. SEE CHART	42	12	22
2	50	21	"	36.	84.	"	"	5.2	68.°	69.°		40	"	13
3	50	16	"	35.	110.	"	"	5.8	68.°	68.°		32	"	6.5
4	50	34	"	30.	44.	"	"	6.1	68.°	70.°		33	"	11.5
5	50	21	"	33.	77.		"	7.6	68.°	70.°		37	"	7.0
ARTS & CRAFTS	25	21	"	7.	*8.		"	11.5	68.°	68.°		38	"	22.
ASSEMBLY E	50	24	"	39.	82.	"	"	6.5	68.°	68.°		32	"	3.
" W	50	16	"	39.	112.		"	4.1	68.°	68.°		32	"	7.
KINDERGARTEN	50		"	36.					69.°				"	
CORRIDOR			TOTAL 1960						65.°				"	

AIR SUPPLY MEASURED AT INTAKE = 15,600 C.F.M.
" " " " SUPPLY REGISTERS = 14,340 C.F.M.
DISCREPANCY BETWEEN AIR MEASURED AT INTAKE AND TOTAL AMOUNT AT REGISTERS IS DUE TO AIR LEAKAGE.
AIR SUPPLY MARKED* ARE COMPUTED FROM CO_2 CONTENT.
CARBON-DIOXIDE CONTENT IN OUTSIDE AIR = 3.1

DEPARTMENT OF HEALTH
CITY OF CHICAGO
DIVISION OF VENTILATION

colonies on two-minute Agar plates. These observations and tests were compared with standard conditions required in the best ventilation practice and conclusions drawn from the comparison.

Test data are tabulated under the heads of the various rooms, giving the number of occupants, air supply, distribution, CO_2 content, temperature, relative humidity and number of colonies developed on a two-minute plate. The columns under "CO_2"—"Temperature," "Relative Humidity" and "Cultures" are tabulated under two headings, the first being that of conditions that should obtain under best ventilation practice; the second the test data collected in the class rooms. In this way convenient comparisons can be made between standard conditions and those observed by test. Culture counts and carbon dioxide tests are averages from two or three observations made in each room. The east kindergarten room was unoccupied at the time of test, therefore no carbon dioxide samples or culture plates were made. Under "Air Supply" tabulations are made in three columns, giving the standard requirement per pupil in a given number; the air supply per seat by test and the air supply per occupant by test.

In those rooms where no air is supplied by the mechanical equipment a determination of air supply per pupil is made from the carbon dioxide determinations. (See foot note on test sheet.) The method of making these determinations is also shown on sheet No. 3, together with the formula used. The amount of air where the mechanical supply is used may also be checked in the same manner.

DISCUSSION OF TESTS.

A careful analysis of test data on above sheet shows conditions on the same much better than those maintained in the average public school building. It will be noted that in class rooms, 2, 3, 4 and 5, in assembly room east and west, and in the kindergarten the air supply exceeds that required by standard practice, with the exception of room No. 4, where it is exactly 30 cu. ft. per seat. The carbon dioxide content by test in all of these rooms is considerably lower than that required by standard practice, as are also the colony counts on two-minute Agar plates. The temperature in rooms 4 and 5 was only 2 degrees higher than good practice dictates, and as the relative humidity was 33% and 37%, respectively, in these rooms the temperature and humidity conditions should be considered satisfactory.

It should be noted in this connection that a temperature of 68° F. in a class room should be accompanied by a relative humidity of 44%, or as near this point as can be maintained.

NOTE: There is a distinct relation between the temperature and humidity in their bearing on comfort. As the temperature goes down the humidity should increase, or vice versa, as the temperature increases the humidity should decrease in the proportion shown by the formula R=316—4T. This is well illustrated by the humidity chart, which was worked out by the Chicago Commission on Ventilation in their experimental room in the Chicago Normal College. (First published in The Heating and Ventilating Magazine for October, 1914.)

Room No. 1, which is being used as a kindergarten at the present time was not originally designed for class room purposes. No air is supplied by the mechanical equipment and the amount obtained through leakage or the limited use of the window was only 25% of that required. The window was open slightly at the time of test.

It will be noted from test data that the CO_2 analysis was 12.2 parts in this room, and that the colonies on test plates average 22. Practically the same conditions prevail in the Arts and Crafts room, where the CO_2 analysis gave 11.5 and the cultures 22. These are the only two rooms where tests indicated conditions that should not prevail.

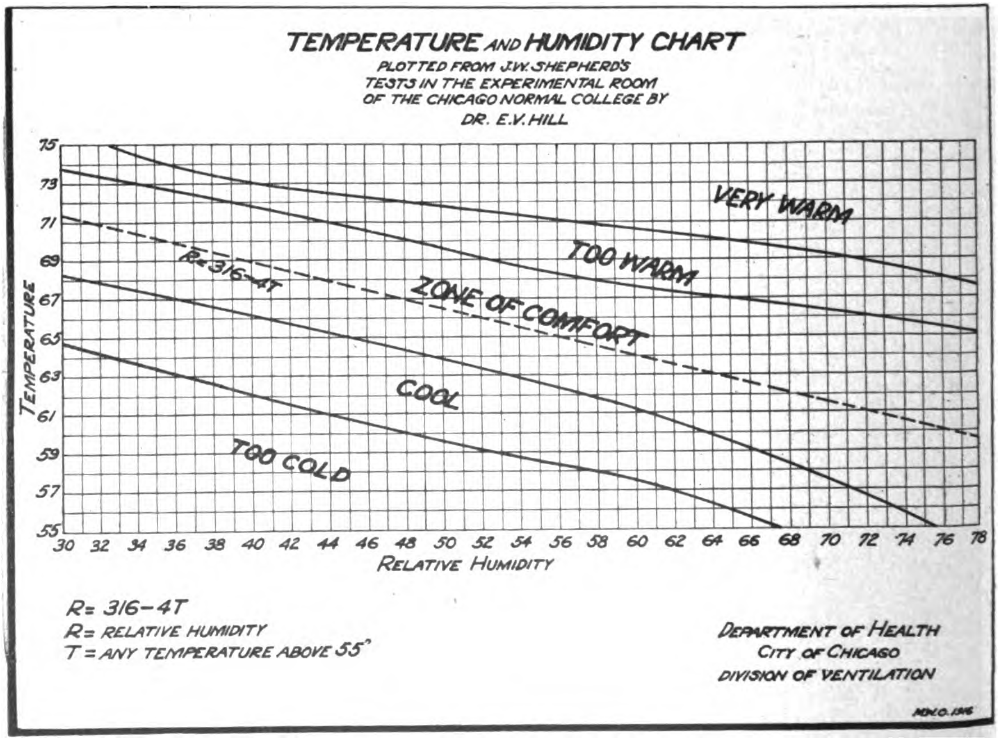
CONCLUSIONS.

The use of room No. 1 as a class room should be discontinued or a mechanical air supply provided. The same is true of the Arts and Crafts room in the basement. With the exception of these two rooms, the assembly room, the corridors and toilets are entirely satisfactory and considerably above the average conditions noted in public school buildings.

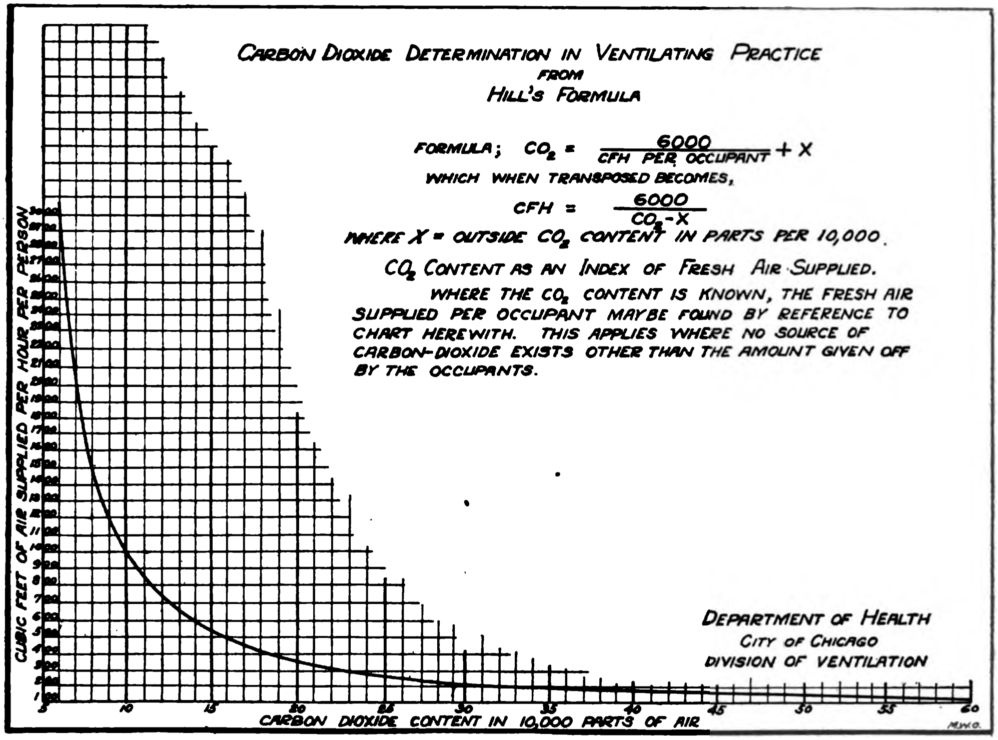
(The report was signed by E. V. Hill and Thomas R. Wilson.)

SUGGESTIONS FOR PLOTTING TEST RESULTS.

After making out the preceding report it became evident that some method was



(*Reprinted from* The Heating and Ventilating Magazine, *for October*, **1914.**)



CARBON DIOXIDE DETERMINATION IN VENTILATING PRACTICE
FROM
HILL'S FORMULA

FORMULA; $CO_2 = \frac{6000}{\text{CFH PER OCCUPANT}} + X$

WHICH WHEN TRANSPOSED BECOMES,

$$CFH = \frac{6000}{CO_2 - X}$$

WHERE X = OUTSIDE CO_2 CONTENT IN PARTS PER 10,000.

CO_2 CONTENT AS AN INDEX OF FRESH AIR SUPPLIED.

WHERE THE CO_2 CONTENT IS KNOWN, THE FRESH AIR SUPPLIED PER OCCUPANT MAYBE FOUND BY REFERENCE TO CHART HEREWITH. THIS APPLIES WHERE NO SOURCE OF CARBON-DIOXIDE EXISTS OTHER THAN THE AMOUNT GIVEN OFF BY THE OCCUPANTS.

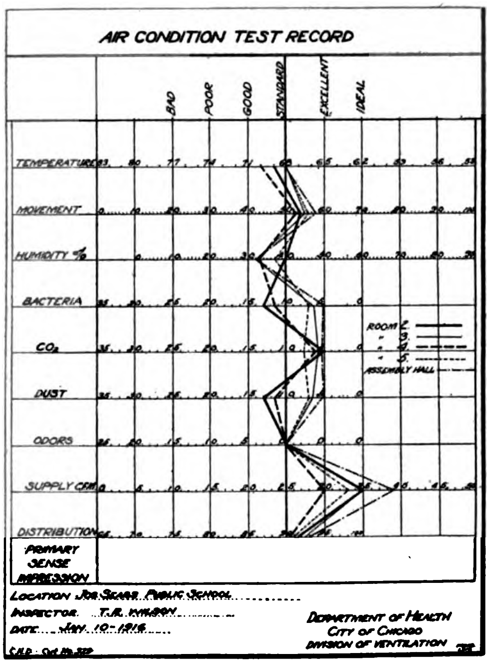
DEPARTMENT OF HEALTH
CITY OF CHICAGO
DIVISION OF VENTILATION

RELATIVE HUMIDITY TABLE
DEGREES FAHR. BAROMETER 30" OF MERCURY

AIR TEMP. t	DEPRESSION OF WET BULB THERMOMETER (t-t')																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
30°	89	78	67	56	46	36	26	16	6																
35°	91	81	72	63	54	45	36	27	19	10	2														
40°	92	83	75	68	60	52	45	37	29	22	15	7	0												
45°	93	86	78	71	64	57	51	44	38	31	25	18	12	6											
50°	93	87	80	74	67	61	55	49	43	38	32	27	21	16	10	5	0								
55°	94	87	82	76	70	65	59	54	49	43	38	33	28	23	19	14	9	5	0						
60°	94	89	83	78	73	68	63	58	53	48	43	39	34	30	26	21	17	13	9	5	1				
65°	95	90	85	80	75	70	66	61	56	52	48	44	39	35	31	27	24	20	16	12	9	5	2		
70°	95	90	86	81	77	72	68	64	59	55	51	48	44	40	36	33	29	25	22	19	15	12	9	6	3
75°	96	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9
80°	96	91	87	83	79	75	72	68	64	61	57	54	50	47	44	41	38	35	32	29	26	23	20	18	15
90°	96	93	89	85	81	78	74	71	68	65	61	58	55	52	49	47	44	41	39	36	34	31	29	26	24
100°	96	93	89	86	83	80	77	73	70	68	65	62	59	56	54	51	49	46	44	41	39	37	35	33	30

RELATIVE HUMIDITY

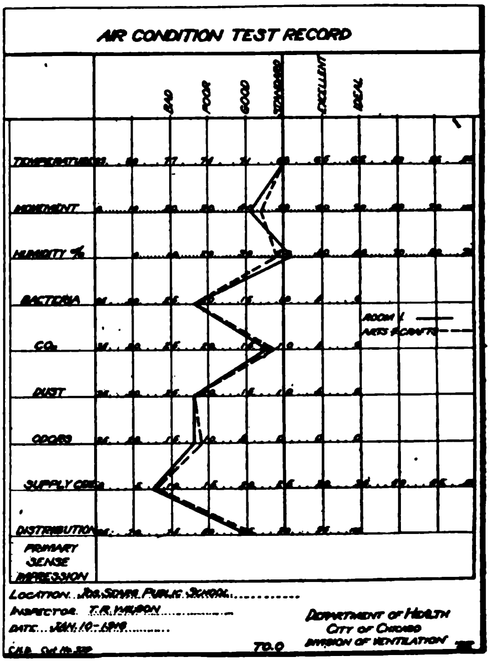
DEPARTMENT OF HEALTH
CITY OF CHICAGO
DIVISION OF VENTILATION



LOCATION Jos. Sears Public School

INSPECTOR T. R. Wilson

DATE Jan. 10-1916



LOCATION Jos. Sears Public School

INSPECTOR T. R. Wilson

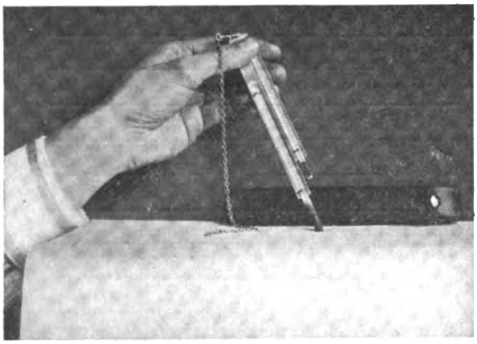
DATE Jan. 10-1916

desirable whereby the results of tests in class rooms could be recorded or plotted in a method that would be easily understood. After some study the accompanying chart was devised and is now being used for work of this kind. It contains data covering all of the important air conditions essential for proper ventilation, graduated under six different headings: Bad, Poor, Good, Standard, Excellent. Ideal.

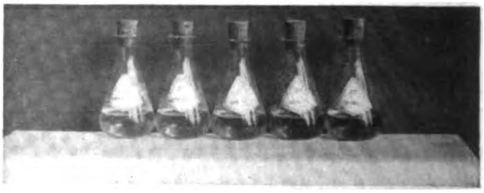
The standard requirements are those which can be maintained at a reasonable expense by a mechanical equipment during those seasons of the year when the windows must be closed. On the line "Excellent" will be found conditions somewhat superior to those designated as "Standard." These conditions can be maintained by a mechanical equipment, although the expense would be considered by some excessive. The "Ideal" conditions could probably not be obtained by any mechanical ventilating device, as the entire elimination of dust and bacteria would be impossible. On the line marked "Good" conditions are found which obtain in the average class room. Under "Poor" and "Bad" the conditions are those that certainly should not be allowed to prevail.

A brief description of the methods used in making the necessary tests for filling out this chart may be of interest:

1.—*Temperatures*: Temperatures are determined by standard thermometers,



7-IN. SLING PSYCHROMETER.



SMALL ERLENMEYER FLASKS CONTAINING GRADUATED ODOR SOLUTIONS.

usually in four locations in a class room. Where extreme accuracy is not essential and dry bulb temperature, as indicated by the sling psychrometer, is used.

2.—*Air Movement*: The extent and velocity of the air movements in a room are determined by the use of a small ammonium-chloride apparatus, as shown in the illustration. It consists of two 100 c.c bottles, one containing hydrochloric acid and the other ammonium-hydroxide, carried in a leather anemometer case. By means of a rubber bulb and a suitable arrangement of tubing air is forced simultaneously through the two bottles and the fumes allowed to intermingle at the nozzle. In this way a cloud of ammonium-chloride is produced which is rather permanent and does not settle out of the air. Selecting a point where the direction of the air movement has been previously determined a small puff of smoke is produced and its velocity determined by means of a stop watch. With a little practice accurate results can be obtained.

3.—*Humidity*: For determining the relative humidity in ventilation work we have found the small 7-in. sling psychrometer, shown in the illustration, much more desirable than the larger models previously employed. The instrument is swung by a chain instead of a pivoted handle, as in the older model. It is compact, portable, and sufficiently accurate for this work.

TAKING AIR SAMPLE FOR CARBON DIOXIDE DETERMINATION.

DETERMINING VELOCITY OF AIR MOVEMENT USING AMMONIUM CHLORIDE APPARATUS.

4.—*Bacteria*: Various methods of determining the number of bacteria in a measured quantity of air have been discarded in practical test work for the simple method of exposing a standard Agar plate for two minutes. While considerable variation is observed under like conditions, still the average of four or five plates in a room is probably as accurate as the other methods.

5.—*Carbon Dioxide*: Air samples for dioxide are taken by means of the Paquelin cautery bulb and a 125 c.c. rubber stoppered bottle. The method is so well known that a description at this time would be superfluous.

6.—*Dust*: Dust determinations are made with the Aitken portable dust counter. Two methods are employed: First, the direct method in which precipitation of the particles is made directly on the object glass and counted before the condensation evaporates. Second, a smoked covered glass is placed in the machine and the precipitation made on this surface. This method makes a permanent record which can be removed and counted with the aid of a microscope at leisure, It is somewhat more difficult to take observations by the second method, but it is more accurate, inasmuch as plenty of time can be taken in making the count.

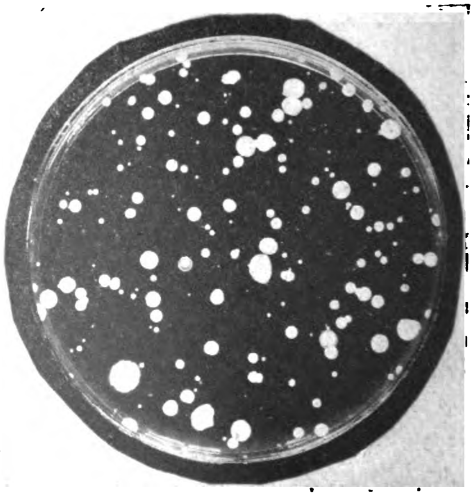
7.—*Odors*: As the individual element plays an important part in the determination of odors some experimental work has been done with the intention of standardizing this test. We have mixed in the form of a solution a large number of chemicals; such as hydrogen-sulphide, butyric acid and others, forming pronounced disagreeable odors, until we obtain a combination that gives a strong disagreeable odor, such as would be noticed under the worst possible conditions. This has been labeled "Strong." Various dilutions of this solution are made and labeled "Decided," "Distinct," "Noticeable" and "Very Faint," with their corresponding numbers on the chart. These various dilutions are used as standard odors and our inspectors are instructed to familiarize themselves with the same in order that their records of test may bear some similarity. This must be considered as a beginning only in attempting to standardize a difficult test.

MAKING DUST COUNT WITH AITKIN MACHINE (DIRECT METHOD).

EXPOSING AGAR PLATE FOR BACTERIA DETERMINATION.

8.—*Supply*: The air supply where a mechanical equipment is in use is determined by anemometer readings at the inlet openings. This is checked by computations from the average CO_2 analysis in the room.

9.—*Distribution*: The extent of distribution is worked out on a percentage basis. Referring to the chart, the standard conditions require 90% distribution, as it is evident that perfect distribution cannot be obtained. The percentage of distribution is determined by noting to



PHOTOGRAPH OF 5-MIN. AGAR PLATE CULTURE CONTAINING 221 COLONIES.

what extent the various CO_2 samples throughout the room vary from the average of all the samples. This variation is expressed in percentage.

A Character Study of the American Engineer

BASED ON THE OPINIONS OF 1400 MEMBERS OF ENGINEERING SOCIETIES.

The good and bad points of modern engineering education in the United States and their effects on the character and personality of the engineer, are brought out in the replies to nine questions which were received in response to a questionairre sent out by the Carnegie Foundation for the Advancement of Teaching. The questions were submitted to members of the national engineering societies and although the percentage of replies received is small, it is stated that they came from men who are successful engineers, have positions of authority and are experienced in employing engineering graduates.

Generally speaking, the replies showed that the schools are strongest in imparting technical knowledge and the scientific attitude and that they are weakest in imparting business sense, ability to apply theory to practice and power of expression. Of the factors making for success in engineering, the greatest emphasis was placed by the engineers replying upon character, self-reliance and independence and understanding of men.

Incidentally the following facts were mentioned as a basis for the opinions expressed in many of the replies. (The numbers in parenthesis indicate the number of times that the statement occurs.)

Engineers as a rule do not frame the policy for public improvements, but are hired as help (17); engineers seldom serve in the legislature or on public commissions (1). In engineering meetings ten per cent. of the members do the talking (2); engineering literature shows how engineers fail to convey their meaning (5); engineers cannot convince an audience (1). Only about half of the engineering graduates follow their specialty (8); there are not enough positions open to graduates of engineering colleges (2). Men trained in pure science make as successful engineers as those trained in engineering (2). Many mentally brilliant engineers have no greater earning power than carpenters' foremen (2); engineers take business courses in correspondence schools (1); few engineers arrive under the age of forty (1).

QUESTIONS 1, 2 AND 9.

What are the particular points at which the work of the engineering schools is effective and successful?

What are the particular points at which the work of the engineering schools is least effective and successful?

Make specific suggestions for the improvement and strengthening of engineering schools.

The answers to these questions showed generally that technical knowledge is effectively taught, that scientific thinking is also effectively taught and that the schools are successful in instilling ambition. As regards self-reliance, the general opinion was that the schools did not develop this attribute as much as they might, instances being enumerated where engineers had shown lack of decision and leadership, sense of authority, perseverance and responsibility.

The same opinion held true concerning industry, there being a tendency towards a lack of willingness to work, a lack of discipline and an aversion to buckling down to dirty work.

On the point of developing character, it was felt that this was not being accomplished with the desired degree of success, especially as regards personality and integrity. An adverse vote was also given on the point of efficiency, it being stated that too many failures were to be found on the points of good use of time, getting results, economy, short methods, concentration, executive ability, scientific management, system and order, and practical methods.

One of the striking results of the investigation was the decisive vote against the success of the schools in developing the physique of the students, including physical training and hygiene.

Other ways in which engineering

schools fail are in developing the engineering spirit and ideals, such as ideals of life, high purpose, professional ideals and understanding of ultimate aim of engineering.

The schools are deficient in the matter of legal and political training and in promoting the proper spirit of independence, such as initiative, resourcefulness, fairness, imagination, promptness, determination, decision and loyalty.

Humility is also insufficiently developed, too few taking the attitude of having more to learn and of beginning at the bottom. The schools fail to inculcate the necessary accuracy, including precision, detail, thoroughness and neatness.

Engineering judgment, it was stated, is frequently lacking in graduates who also are apt to show a lack of individual instruction in their college course, which would have been brought about by personal contact, vocational guidance, weeding out of the unfit and of not crowding the classes.

Ability to understand men is likewise insufficiently developed in engineering schools, this including ability to handle men, to judge character, to mix well and to develop tact and social address.

Graduates have not, as a rule, breadth of view, which would be obtained through general culture, general education, relation of engineering to other human activities and to a general perspective of life.

It was brought out emphatically that too few of the teachers are trained in practical work and are in constant touch with it. There are also too many subjects taught, too much useless information, too much detail, too systematic an arrangement of the curriculum, too many subjects chosen to please the professors rather than the students and too little co-operation among the departments.

Students are not taught sufficiently the power of expression, such as the use of English, the ability to express one's self in speech and writing and in public speaking.

Concerning the application of theory to practice it was felt that the schools failed in this respect also, such as ability to apply mathematics, solution of indeterminate problems, use of instruments and tools, practical experimental work, technique of engineering, knowledge of materials, shop methods, methods of construction and mechanical drawing.

Finally the schools do not impart as they should the business sense, including commercial address, bookkeeping, business principles, economics of engineering and business-like methods.

QUESTIONS 4, 5 AND 6.

What are the most important factors in determining probable success or failure in engineering?

When examining a candidate for a prospective job, what sort of information is best calculated to assist in judging his fitness and probable success? Give samples.

What sort of work, what specific jobs, what kind of experiences are most effective in testing a man for fitness and probable success in engineering? . Give samples.

These three questions are summarized together as far as the factors that make for success in engineering are concerned, because these factors were mentioned in the answers to all three. The following table contains the factors grouped about leading ideas arranged according to the number who mentioned them:

Character—Integrity and honesty and personality.

Self-reliance—Decision, responsibility, perseverance, persistence, grit, gumption, nerve, force, determination, enterprise, sand, firmness, endurance, ability to endure hardships, courage, loyalty, fidelity and reliability.

Ability to Understand Men.—To handle men, tact, unity and brotherhood, ability to co-operate, to judge men, to gain and keep the confidence of men, adaptability.

Engineering Spirit.—Ideals of engineering, natural bent, innate ability, capacity, aptitude, mechanical ability, temperament, imagination, foresight, aim—self or work.

Independence — Initiative, inventiveness, ingenuity, originality, creative ability, aggressiveness, push resourcefulness, "pep," versatility.

Judgment — Discernment, common sense, balance, perspective, proportion.

Industry—Energy, application, concentration, willingness to work, capacity for work, how to do dirty work.

Technical Knowledge—grasp of fundamentals, knowledge of theory, technical training, knowledge of subject.

Scientific Attitude—Logical thinking reasoning power, analysis, ability to face facts to observe, to profit by failure, optimism, openmindedness, disinterestedness, studiousness.

Accuracy—Precision, care for detail, thoroughness, neatness.

Efficiency—Executive ability, promptness, speed, system and order, methods of work.

Business Sense—Commercial training, knowledge of business, value of money, how to market his services.

Breadth of View—General education.

Ambition—Enthusiasm, interest, alertness.

Power of Expression—Ability to convince, to converse well.

Humility—Willingness to start at the bottom, patience, conscientiousness, sincerity, obedience, morality, religion, self control, lack of big head.

Application of Theory to Practice.

Physique—Physical health.

Luck in Striking Right Job—Opportunity, influential family and friends.

Same as in Other Work.

Memory.

The following is a list of the replies to question 5 as to the sort of information best calculated to assist in judging fitness and probable success in engineering, arranged according to the times mentioned:

Experience, record of experience, success in previous work, rate of promotion; personal impression, general appearance, address, quick wit, ability in presenting his case, conversational ability; previous training, schooling, college record, preparation; personal interests, personal habits, associates, boyhood experiences, spend spare time, outside reading; opinions of others on character, on work, references; aim—self or work, money or use, common welfare, attitude towards service; length of service, reasons for leaving jobs; family history; ability to pass examination on requirements; opinion of self and his own work; did he work his way through school?—finances; understanding by employer of what sort of characteristics are needed.

In answering Question 6 most of those replying suggested as the thing most effective in testing a man's fitness and probable success, any work requiring one or more of the factors of success summarized under Question 4. In addition, other specific suggestions were: Emergency work, trouble work, correcting others' failures, solving of problems not clearly stated, correcting incomplete drawings, writing a report that carries conviction, analysis of unfamiliar problems, special task in his specialty, apprentice work, running test on machines, making inventory of bill of material, search for data or needed information, speaking before an audience.

QUESTION 7.

Have you ever found a knowledge of either French, German or Spanish essential to your professional career?

Most of the answers received were in the negative. Of the balance, the knowledge of foreign languages was favored in the following order: Spanish, German, French, both French and German and Italian.

QUESTION 8.

Should a reading knowledge of one of the modern languages be required of every engineer? Why?

About half of those who replied thought that at least one foreign language should be required in the engineering schools, for the reason that it develops culture and breadth of view. The other half stated that the returns to students are not at all commensurate with the time spent.

Central Station Heating in Wadena, Minn.

DATA OF A SMALL PLANT THAT IS EARNING AT THE RATE OF 12.8% PER ANNUM

By L. A. LARSEN.

The recently-installed central heating plant in Wadena, Minn., consists of 980 ft. of 8-in. and 260 ft. of 6-in. steam mains with 3-in. return for the first and 2-in. return for the 6-in. mains. This system has 14,000 sq. ft. of radiation connected with piping equivalent to about 5,000 sq. ft. more, making a total of about 19,000 sq. ft.

On this system we are carrying from 3 to 5 in. of vacuum in the steam mains and from 11 to 14 in. in the return pipes. The efficiency of this plant can best be judged by the following figures taken from a test of a week's duration on the power plant:

Average boiler horse power per hour	78.5 B.H.P.
Average kilowatt-hour output	31.5 K.W.H.
Average daylight load from 6 A. M. to 4:30 P. M.	27 K.W.H.
Average water evaporated in boilers for K.W.H. output	71.2 lbs.

Whenever the load on the engine reached 110 amperes, 250 volts, no live steam was used to heat the system when the outside temperature was 10° F. below zero. This shows that 64.1 B.H.P. was sufficient to supply the system at the outset temperature mentioned.

Following is a statement of business of the company operating this plant, made on June 21, 1915. The company commenced operating the plant about December 10, 1914:

LIABILITIES.	
Capital stock, fully paid at par	$10,000.00
Bills payable	1,300.00
Milwaukee Conduit and Insulation Co.	125.00
Revenue received from operating plant	1,962.29
Total	$13,387.29

ASSETS.	
Balance in Merchants' National Bank	$66.62
Plant at cost	12,236.93
Supplies on hand	187.47
Expense of operating plant	896.27
Total	$13,387.29

Revenue	$ 1,962.29
Less expense	896.27
Net revenue	$ 1,066.02

The heating season for the winter of 1914-1915 at Wadena was approximately 57% of a full season, based upon the following facts. Prior to January 12, 1915, only 3,350 sq. ft. of radiation was connected. Between January 12 and February 12 the balance of the radiation was connected, there being a total, as stated, of about 14,000 sq. ft.

Based on the Wadena Heating Company's statement to its stockholders, shown above, the plant, even in this short season, produced a net revenue of $1,066.02, which equals 8.71% on the investment. The item of operating expense includes a steam fitting bill of approximately $100 for cleaning traps, etc., which would probably have been no greater for a full season.

Had the Wadena Heating Company been in operation for a full heating season its gross revenue would have been increased 43%, or to $2,806.07. The operating expenses, minus the $100 steam fitting bill, would have been increased by 43%, or ($896.27—$100) x 43%=$342.40. $342.40+$896.27=$1,238.67. The company's net revenue would then have been $1,568.40, which equals 12.8% on the investment.

The rate to consumers in Wadena is 45 cents per 1,000 lbs. of steam condensation and the above-mentioned results were derived from this rate. Had the company had a sliding scale of rates to consumers in which the average rate would have been 64 cents per 1,000 lbs. of condensation, as it should have been, the company would have received 19 cents per 1,000 lbs. more revenue, or 42.2% increase in revenue, without any increase in operating expenses. The results for the partial season, as given in the statement, would then have been:

Gross revenue	$2,790.37

Operating expense	896.27
Net profit	$1,894.10

This is equivalent to 15% on the investment.

Again, had the company's plant operated for the full heating season at such an advanced rate, its gross revenue, based on the foregoing facts, would have been $3,991.65. The operating expense would have been, as before, $1,238.67 and the results would then have been:

Gross revenue	$3,991.65
Operating expense	1,238.57
Net revenue	$2,752.98

or 22.5% on the investment.

It will be of interest to add that the insulation used is 1-in. asbestos expanded covering, with 3-ply Gilsonite roofing felt jacket in the Milwaukee Conduit and Insulation Company's vitrified salt-glazed conduit, laid on an average of 5 ft. below the surface.

Cost of Removing and Replacing Pavements Incident to the Installing of Heating Lines in City Streets

BY W. F. VERNER.

Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 18-20,1916.)

One of the principal factors to be considered in constructing a distribution system for heating relates to the tearing up of the pavements in the city streets, and replacing the same in good condition. In most cities permission must first be granted before construction is begun, and in many cities it is customary for the municipality to do all repairing relative to the streets, and bill the company installing the system for the labor and material expense, incident to the repaving over the mains and services.

The manner pursued in constructing the system plays an important part. The customers must first be secured before extending a line, and after a period of years it is found that the total cost of construction is more than if the system had all been put in at once. That is, the work is done piecemeal. The cost of removing and replacing the pavement per square yard is necessarily higher than what a contractor would charge if he were paving an entire street. The following tables are the results of an extended study of actual costs.

The gangs doing this work generally consist of 6 men and a foreman; laborers, $2.50 per day; foreman, $3.60 per day of 9 hours. Distributing the foreman's time to each laborer will make a

TABLE 2—COST TO REMOVE VARIOUS KINDS OF PAVEMENT PER LINEAL FOOT OF TRENCH.

Width of Trench, Inches	Sheet Asphalt on 6" Concrete	Brick on 6" Concrete	Cedar Block on 6" Concrete	Cedar Block on Sand	Concrete 6"	Creosoted Block on 6" Concrete	Granite Block on 6" Concrete	Cobblestone on Sand
22	$0.09	$0.09	$0.06	$0.03	$0.03	$0.07	$0.10	$0.03
23	.09	.09	0.7	.03	.04	.07	.11	.03
24	.10	.10	.07	.03	.04	.07	.11	.03
25	.10	.10	.07	.03	.04	.08	.11	.03
26	.10	.10	.08	.04	.04	.08	.12	.03
27	.11	.10	.08	.04	.04	.08	.12	.03
28	.11	.11	.08	.04	.04	.09	.12	.03
29	.12	.11	.08	.04	.05	.09	.13	.04
30	.12	.11	.08	.04	.05	.09	.13	.04
31	.12	.12	.09	.04	.05	.09	.13	.04
35	.14	.13	.10	.04	.05	.10	.14	.04
36	.14	.13	.10	.04	.06	.10	.15	.04
37	.14	.13	.10	.05	.06	.11	.15	.04
39	.14	.14	.11	.05	.06	.12	.16	.05
41	.15	.15	.11	.05	.06	.12	.16	.05

charge of $3.10 for the work accomplished by each laborer.

TABLE 1

	Square yards removed for day of nine hours per man.	Cost per sq. yd. for removing.
Sheet Asphalt	13.05	$0.24
Brick	16.83	0.18
Concrete foundation ..	16.11	0.19

Cedar Block, Creosoted Block and Cobblestone	27.00	0.12
Granite Block.........	14.04	0.22

The above costs are used in preparing Table 2.

REPAIRING ASPHALT.

(Cost per Sq. Yd)

A flate rate for repairing asphalt, not including foundation, is $1.50.

A 6-in. concrete foundation will cost approximately the same as concrete pavement, or $1.54 per sq. yd.

TABLE 3—HOURS LABOR AND MATERIAL QUANTITIES FOR REPAIRING PAVEMENTS, UNITS PER SQUARE YARD (All old material is used where possible).

	Brick on 6" Concrete	Cedar Block on 6" Concrete	Cedar Block on Sand	Concrete 6"	Creosoted Block on 6" Concrete	Granite Block on 6" Concrete	Cobblestone on Sand
Foreman's time (hrs.)......	0.36	0.80	0.18	0.34	0.36	0.31	0.11
Paver's time (hrs.).........	0.66	0.90	0.44	0.55	0.85	0.76	0.33
Laborer's time (hrs.).......	1.89	1.10	0.67	1.53	2.01	2.43	0.75
Team time (hrs.)...........	0.75	1.10	0.44	0.63	0.88	0.64	0.33
Cu. ft. of sand.............	1.18	1.50	1.11	1.20	1.08	1.68	0.76
Sacks of cement............	0.34	0.30	..	0.60	0.43	0.66	0.03
Gallons of tar..............	1.11	..	..	..	0.72	..	0.18
Brick No. 1................	3.89	..	..	..	..	..	0.25
Brick No. 2................	1.65	..	..	..	..	..	..
Sp. yds. cedar block, No. 2..	..	0.65	0.41	..	..	..	..
Sq.yds. creosoted block, No. 1.	..	..	..	..	0.24	..	..
Sq. yds. granite block.......	..	..	..	..	..	0.10	..
Cu. ft. crushed stone.......	0.09	..	..	0.06	0.06	..	..
Cu. ft. gravel..............	..	0.20	0.67	..	..	..	..
Gallons of oil..............	0.01	..	..	0.01	0.01	0.29	..
Luber F. B. M............	..	..	..	..	..	..	..
Spikes	..	..	..	..	..	..	..
Total number of yards averaged	2187.5	10.0	13.5	685.5	301.0	95.0	127.0

REPAIRING BRICK PAVEMENT ON 6-IN. CONCRETE.

(Cost per Sq. Yd.)

Foreman	0.36 hrs.	@ $0.50	$0.18	
Paver	0.66 hrs.	@ 0.40	0.26	
Laborer	1.89 hrs.	@ 0.25	0.48	
Team	0.75 hrs.	@ 0.44	0.33	
				$1.25
		15%		0.19
				$1.44
Sand	1.18 cu. ft.	@ $0.06	0.07	
Cement	0.43 sacks	@ 0.40	0.17	
Tar	1.11 gals.	@ 0.12½	0.14	
Brick, No. 1	3.89	@ 25.00	0.10	
Brick, No. 2	1.65	@ 18.00	0.03	
Crushed Stone	0.09 cu. ft	@ 0.05	0.004	
Oil	0.01 gal.	@ 0.08	0.001	0.51
		Total		$1.95

REPAIRING CEDAR BLOCK ON 6-IN. CONCRETE.

(Cost per Sq. Yd.)

Foreman	0.80	hrs.	@	$0.50	$0.40	
Paver	0.90	hrs.	@	0.40	0.36	
Laborer	1.10	hrs.	@	0.25	0.28	
Team	1.10	hrs.	@	0.44	0.48	
						$1.52
			15%			0.23
						$1.75
Sand	1.50	cu. ft	@	$0.06	$0.09	
Gravel	0.20	cu. ft	@	0.06	0.01	
Cement	0.30	sack	@	0.40	0.12	
Cedar Block, No. 2	0.65	sq. yds.	@	0.38	0.25	$0.47
Total						$2 22

REPAIRING CEDAR BLOCK ON SAND.

(Cost per Sq. Yd.)

Foreman	0.18	hrs.	@	$0.50	$0.09	
Paver	0.44	hrs.	@	0.40	0.18	
Laborer	0.67	hrs.	@	0.25	0.17	
Team	0.44	hrs.	@	0.44	0.19	
						$0.63
			15%			0.09
						$0.72
Sand	1.11	cu. ft.	@	$0.06	$0.07	
Gravel	0.67	cu. ft	@	0.06	0.04	
Cedar Block, No. 2	0.41	sq. yds.	@	0.38	0.16	$0.27
Total						$0.99

REPAIRING CONCRETE 6-IN.

(Cost per Sq. Yd.)

Foreman	0.34	hrs.	@	$0.50	$0.17	
Paver	0.55	hrs.	@	0.40	0.22	
Laborer	1.53	hrs.	@	0.25	0.38	
Team	0.63	hrs.	@	0.44	0.28	
						$1.05
			15%			0.16
						$1.21
Sand	1.20	cu. ft	@	$0.06	$0.07	
Cement	0.60	sacks	@	0.40	0.24	
Lumber	0.36	F.B.M.	@	35.00	0.01	
Crushed Stone	0.06	cu. ft	@	0.05	0.003	
Spikes	0.03	lbs.	@	0.02	0.001	
Oil	0.01	gals.	@	0.08	0.001	$0.33
Total						$1.54

REPAIRING CREOSOTED BLOCK ON 6-IN CONCRETE.

(Cost per Sq. Yd.)

Foreman	0.36	hrs.	@ $0.50	$0.18	
Paver	0.85	hrs.	@ 0.40	0.34	
Laborer	2.01	hrs.	@ 0.25	0.50	
Team	0.88	hrs.	@ 0.44	0.39	
					$1.41
			15%		0.21
					$1.62
Sand	1.08	cu. ft.	@ $0.06	$0.06	
Cement	0.43	sacks	@ 0.40	0.17	
Tar	0.72	gals.	@ 0.12½	0.09	
Creosote Block, No. 1	0.24	sq yds.	@ 2.00	0.48	
Crushed Stone	0.06	cu. ft.	@ 0.05	0.003	
Oil	0.01	gals.	@ 0.08	0.001	$0.80
Total					$2.42

REPAIRING GRANITE BLOCK ON 6-IN. CONCRETE.

(Cost per Sq. Yd.)

Foreman	0.31	hrs.	@ $0.50	$0.16	
Paver	0.76	hrs.	@ 0.40	0.30	
Laborer	2.43	hrs.	@ 0.25	0.61	
Team	0.64	hrs.	@ 0.44	0.28	
					$1.35
			15%		0.20
					$1.55
Sand	1.68	(cu. ft.	@ $0.06	$0.10	
Cement	0.66	sacks	@ 0.40	0.26	
Granite Block	0.10	sq. yds.	@ 2.35	0.24	
Oil	0.29	gals.	@ 0.08	0.02	$0.62
			Total		$2.17

REPAIRING COBBLE PAVEMENT ON SAND.

(Cost per Sq. Yd.)

Foreman	0.11	hrs.	@ $0.50	$0.06	
Paver	0.33	hrs.	@ 0.40	0.13	
Laborer	0.75	hrs.	@ 0.25	0.19	
Team	0.33	hrs.	@ 0.44	0.14	
					$0.52
			15%		0.08
					$0.60
Sand	0.76	cu. ft.	@ $0.06	$0.05	
Cement	0.03	sacks	@ 0.40	0.01	
Tar	0.18	gals.	@ 0.12½	0.02	
Brick	0.25		@ 25.00perM.	0.01	$0.09
			Total		$0.69

Using the above costs per square yard for the various pavements, Table 4 is compiled.

TABLE 4—COST TO REPLACE VARIOUS KINDS OF PAVEMENT PER LINEAL FOOT OF TRENCH.

Width of Trenches, Inches	Sheet Asphalt on 6" Concrete	Brick on 6" Concrete	Cedar Block on 6" Concrete	Cedar Block on Sand	Concrete 6"	Creosoted Block on 6" Concrete	Granite Block on 6" Concrete	Cobblestone on Sand
22	$0.62	$0.60	$0.58	$0.26	$0.28	$0.75	$0.67	$0.17
23	.65	.62	.60	.27	.29	.77	.69	.17
24	.65	.62	.62	.28	.29	.77	.69	.18
25	.68	.64	.62	.28	.31	.80	.72	.18
26	.71	.66	.64	.29	.32	.82	.74	.19
27	.74	.68	.67	.30	.34	.85	.76	.19
28	.77	.70	.69	.31	.35	.87	.78	.20
29	.80	.72	.71	.32	.37	.90	.80	.21
30	.80	.72	.71	.32	.37	.90	.80	.21
31	.83	.74	.73	.33	.38	.92	.82	.22
35	.94	.80	.80	.36	.43	.99	.89	.24
37	.99	.83	.84	.38	.46	1.04	.93	.25
39	1.03	.87	.89	.40	.49	1.09	.98	.26
41	1.08	.89	.91	.41	.51	1.11	1.00	.28

Notes on Compulsory Heating and Ventilating Requirements.

In connection with the requirements for compulsory heating and ventilating laws, which were published in the last issue, the council of the Heating and Ventilating Engineers' Society calls attention, among other things, to the fact that the committee report deals with old buildings as well as new. The city of Chicago makes its ventilation laws apply to both old and new buildings with good results, yet there are some who object to making legal requirements apply to buildings other than new buildings. If, in any case, the suggestions are used to apply to new buildings only, some modified requirements, as near the requirements for new buildings as possible, should, in the interests of public health, be enforced for existing buildings.

If is often desirable to have humidifying apparatus and humidity control, but because of the expense of such equipment, humidity control (except as to keeping down excessive humidity) has been omitted from the suggested requirements.

It is important to note that the suggestions given in the report are for average localities in the United States, taking New York, Boston and Chicago as examples.

Specific rules, not included therein, will be needed covering details of installation and operation, such, for example, as have been formulated and adopted with excellent results by the Department of Health in the City of Chicago and the Industrial Commission of the State of Wisconsin.

The removal from work rooms of objectionable dusts, fumes, gases, vapors, odors, fibres and other impurities created in manufacturing processes, covered by the general requirements in the report, is vitally important and will require specific rules that are practical and that may be widely applied. Space conditions per occupant should, under these conditions, be most liberal. Some good rules for the removal of dust, etc., for manufacturing establishments, have been drawn up by the 1915 Industrial Board of the New York State Department of Labor and by the Industrial Commission of Wisconsin.

The administrative feature of enforcing general ventilation laws are extremely important and experienced and capable engineers are necessary as inspectors and as advisers to the administrative department.

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Humidity and Its Measurement.

A Correction.

The last equation given in the article on "Humidity and Its Measurement," on page 37 of the March issue, may need a little further explanation, aside from the fact that a typographical error occurs in one of the equations. The equation to be solved for X should read:

$$0.2375 \times 70 + \frac{1084.7 + 0.48 \times 16 \times X}{7000} = 22.44$$

1084.7 is the total heat of the vapor at 54°F and 16 is the number of degrees superheat of the vapor (the difference between 50° and 70°F.)

The equation simply states that the total heat of the mixture is equal to the heat of the air, plus the total heat of saturated vapor at 54°, plus the heat required to superheat the vapor from 54° to 70°. In the first equation, the vapor is saturated and therefore, the term involving the superheat does not occur.

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ABOUT as personal and searching a character study as could be imagined is that made recently by one of the Carnegie foundations, with the American engineer as its subject. If he has any illusions about himself they stand a good chance of being dissolved in the bright glare that the study has thrown over his training, his mental attitude, his future prospects and about everything else that would be likely to affect him. In announcing the results of the investigation, the engineer is backed up against the wall, so to speak, and told frankly just about where he "gets off," to use a common expression. Here is the general indictment:

Engineers as a rule do not frame the policy for public improvements, but are hired as help; engineers seldom serve in the legislature or on public commissions; in engineering meetings 10% of the members do the talking; engineering literature shows how engineers fail to convey their meaning; engineers cannot convince an audience; only about half of the engineering graduates follow their specialty; many brilliant engineers have no greater earning capacity than carpenters' foremen; and, finally, few engineers arrive under the age of forty.

So much for their public activities. When it comes to their personal characteristics we are told that their engineering spirit and ideals, such as ideals of life, high purpose, professional ideals and understanding of the ultimate aim of engineering, are not properly developed; that they are deficient in legal and political training and in promoting the proper spirit of independence; also that they are lacking in humility and in engineering judgment.

Equally interesting is the list of factors which are given as those that make for success in engineering. These are placed in the following order of their importance, as expressed by the consensus of the opinions received: Character, self-reliance, ability to understand men, engineering spirit, independence, judgment, industry, technical knowledge, scientific attitude, accuracy, efficiency, business sense, breadth of view, ambition, power of expression, humility, application of theory to practice, physique, and, finally, memory.

The investigation went still further, taking up, among other things, the sort of information best calculated to assist in judging fitness and probable success in engineering.

◆

NEW YORK extends the heartiest of welcomes to the National District Heating Association on the occasion of its forthcoming convention in the metropolis. It is a good thing for the district heating engineers to come in touch with eastern affairs, but we venture to think it is even a better thing for New Yorkers to get a line on this breezy and virile organization that smacks of the West.

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

61—Figuring Capacity of Vacuum Pump.

QUESTION: Is there any known method of determining the required capacity of a vacuum pump for a steam heating system?

ANSWER: It is more or less guess work, as the air leakage and amount of air to be removed from a system in a given period of time is indeterminate in advance and more or less variable in operation. A rule that has been used with good results is as follows: Multiply the condensation as determined by the conditions under which the system is operating by 20 for the displacement of the piston of the pump, with a piston speed of not over 60 ft. per minute, and 50 ft. is better. This simply means a proportion of 19 to 1 of air and water. The condensation is determined by multiplying the square feet of radiation by the B.T.U. loss per hour and dividing by 1,000, or the latent heat at atmosphere and below, or at the pressures and temperatures at which the steam will be condensed.

62.—A Vapor Job That Gives Trouble.

QUESTION: I would like to ask for a little information in regard to a vapor job that I am having trouble with. The building is a 5-story apartment. The heating system works very well with the exception of one riser which is the last riser on the return main. The supply riser in question is taken off the main in the center of a run of about 60 ft. This riser is 1-in. up to the third floor and ¾-in. from the third to the fifth floor. The connections to the radiators are taken from a cross, supplying radiators on each side of the partition. There is a total of 143 sq. ft. of radiation on this riser, 69 sq. ft. of this being on the fourth and fifth floors.

The radiators on the three lower floors get hot with a pressure of about ¼-lb., but the upper floor radiators will not get hot unless there is 1 lb. pressure or more. As soon as the pressure drops below that, the radiators become cool and will not heat up until the pressure is again increased.

When there was ½-lb. pressure, with the third floor radiators hot and the fourth floor radiators cold, I have experimented by disconnecting one of the fourth floor radiators and blowing into the supply pipe. The vapor would start to come up and would throw out about a cup of water.

I have changed the connections at the main floor from the riser by putting in a tee at the bottom of the riser, with a side opening on the riser and connected an opening onto the main, and the other opening to a seal with a drop of about 5 ft. and let it overflow into the return main, but still it would not work.

ANSWER: The description shows that the pipe sizes are too small for the pressure carried. The density of the steam changes quite rapidly at atmosphere and below, and by increasing the pressure the weight per cubic foot increases. If the other risers work all right, take a connection of 1¼ in. or 1½ in. from the boiler direct to the end of the supply main and connect it, covering it well. This will equalize the pressure and this will probably make the riser work. If not, the connection between the main and the radiators is too small and will have to be enlarged.

Another method is to run a pipe to the roof space and connect it to the top of the riser. This depends mainly on the structural conditions in the building.

◆

New Unit Proposed for Measurements and Calculations.

Because of objections to both the metric and English systems of measurement, based on the fact that the unit in each case is not easily divisible, a new system is proposed by the Practical Engineer of Chicago, in which the standard of length is 5 ft., or 60 in., to be called the New Unit, or Nu, for short. The point is made that with the metric system, only 2 and 5 are available as even divisions of the unit, and one-fifth is not a natural or convenient division for ordinary work. On the other hand, with the decimal system, division into tenths and fifths is bothersome and inaccurate, the natural division being by halves, thirds and quarters.

The unit of 60 in., or 5t ft., is divisible by 2, 3, 4, 5 and 10. It is equal to 1.524 meters, and to 152.4 centimeters, and this conversion factor is divisible by 2, 3 and 4.

With reference to larger measurements the mile is 1056 nu. If a Greater Unit, on gu. be taken, as 1,000 nu. or 5,000 ft., it will equal 1,524 meters or 1.524 km., so that the same conversion multipliers will hold between the gu. and the kilometer as between the nu. and the meter.

For areas the square new unit equals 2,322 square meters or 25 sq. ft., and for volumes the cubic new unit equals 3.54 cubic meters or 125 cu. ft. And to correspond to the gallon, a cube of 0.1 the new unit on a side or 6 in. might be used, giving a volume of 216 cu. in. or 1/8 cu. ft. or 3540 cu. centimeters.

If we wish to divide the new unit decimally, 0.1 nu.=6 in., 0.5 ft., or 15.24 c.m.,; 0.01 nu. = 0.6 in., 0.05 ft., or 1.524 c.m. and 0.001 nu.=0.06 in. or 1,524 m.m., all of which maintain the same relative simple relations as the new unit, the foot, the inch and the meter.

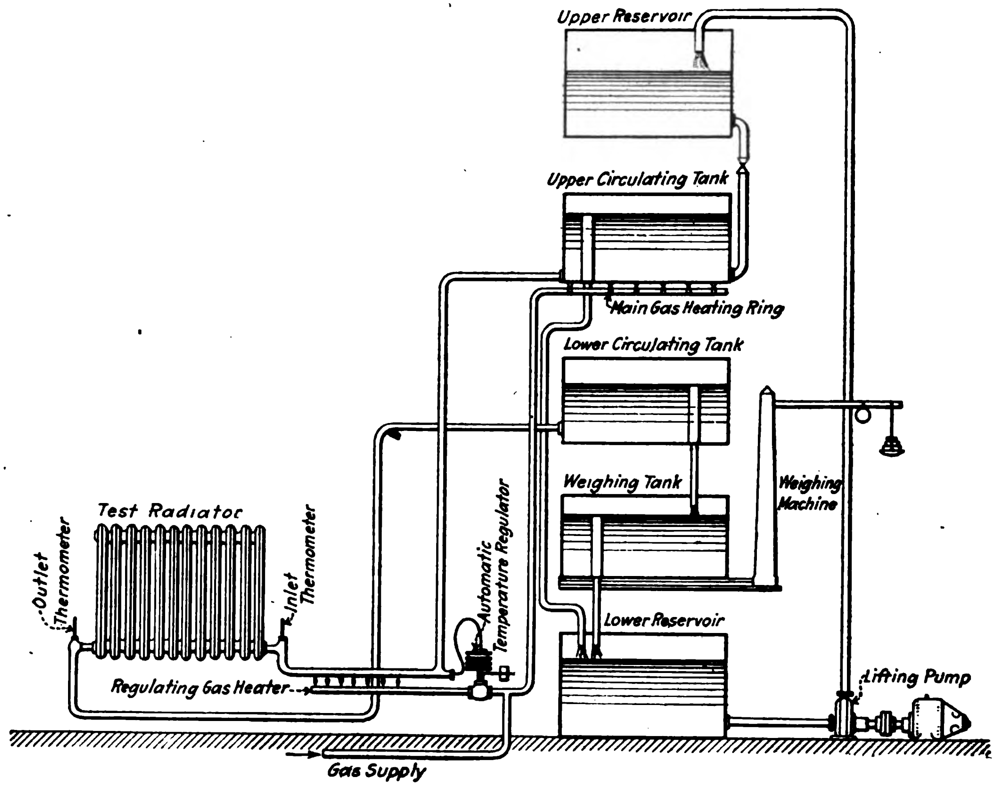
◆

Apparatus for Testing Heat Transmission from Radiators.

Supplementing the description in the March issue of the apparatus designed by A. H. Barker, of the University College, London, for measuring heat losses from rooms, an illustration is presented herewith of another apparatus, also designed by Mr. Barker, for determining the actual amount of heat lost from radiators and pipes at different temperatures.

This apparatus has been thoroughly tested and Mr. Barker states that results can be obtained that will be strictly comparable with practical conditions of any type of radiator.

It is proposed that every type and design of radiator be submitted by the manufacturers for tests and that a schedule of the heat emission at all temperatures applicable to the various types be issued by the manufacturers, in place of the currently-accepted heating surface in square feet, and that all calculations of heat emission should be made by these coefficients.



APPARATUS FOR TESTING HEAT LOSSES FROM RADIATORS BY WATER.

Motion Picture Houses in New York City Inadequately Ventilated.

Announcement is made by the New York City Department of Health that 334 motion picture theatre houses out of a total of 518 in Manhattan, Brooklyn and the Bronx, are so improperly ventilated as to be a menace to the public health. It is stated that the proprietors of these houses have stopped the fans which most of them have installed, in order to save expense, and have also kept the entrances and exits tightly closed. In many cases, it is claimed, disinfectants are being used to disguise the odor of the vitiated air. In addition to the 77 houses which are properly ventilated, there were 107 not in operation. This leaves 334 which have been cited to appear before the license commissioner.

The report of the Health Department is the result of a systematic investigation made March 18, last. This date was chosen because the weather was cold and the problem of getting fresh air correspondingly simpler. It was found that almost all the theatres had the facilities with which to comply with the ordinance, but that they did not operate them on account of the cost.

REQUIREMENTS OF DEPARTMENT OF HEALTH REGARDING HEATING AND VENTILATION OF PICTURE THEATRES.

The department's requirements are contained in the city's Code of Ordinances, Chapter 3, covering amusements and exhibitions. Article 2 is devoted to "Motion Picture Exhibitions," and the two sections relating to the heating and ventilation of such places are Sections 37 and 39:

Sec. 37. Heating. When the temperature of the outdoor air is below 60° F., the air in a motion picture theatre, while an audience is present, shall be maintained at a temperature not lower than 62° F., nor higher than 70° F. If gas stoves, oil stoves or other apparatus throwing off products of combustion are used to heat such a theatre, said products of combustion must be carried to the outside air by means of a fireproof flue or flues. No radiator shall be placed in the aisles of such a theatre, so as to lessen the width below the minimum requirements. (C. O. Sec. 352e, subd. 2.)

Sec. 39. Ventilating. Motion picture theatres as defined aforesaid, having less than 200 cu. ft. of air space for each person, or motion picture theatres in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artificial means of ventilation which shall supply, during the time when the audience is present, at least 500 cu. ft. of fresh air per hour for each person.

Motion picture theatres having more than 200 cu. ft. of air space for each person, or having outside windows and doors the area of which is equal to at least one-eighth of the floor area, shall be provided with artificial means of ventilation, that shall be in operation when the outside temperature requires the windows to be kept closed and which shall supply, during the time the audience is present, at least 500 cu. ft. of fresh air per hour for each person.

When the artificial ventilation is not in operation, ventilation by means of open doors and windows shall be sufficient to provide each person with 500 cu. ft. fresh air per hour.

Motion picture theatres having more than 1,000 cu. ft. of air space for each person, and having outside windows and doors the area of which is equal to at least one-eighth of the total floor area, shall not be required to have artificial means of ventilation, provided the air is thoroughly changed by freely opening doors and windows immediately before the admission of the audience and at least every four hours thereafter.

No part of the fresh air supply required by any paragraph of this section shall be taken from any source containing vitiated air. The area of outside doors and windows shall mean the area capable of being fully opened to the outside air for ventilation purposes. Where fresh air is supplied by means of ventilating openings, at least one inlet shall be situated at one end of the room, and at least one outlet at the other end of the room. Where exhaust or inlet fans are necessary, at least one of such fans shall be placed in an outlet opening. The inlet opening or openings shall be placed in the floor or within 2 ft. from the floor and the outlet opening or openings in the ceiling, or within 2 ft. of the ceiling. The inlet openings and their surroundings shall be kept free from dust, so that the incoming air shall not convey dust nor stir up dust as it enters.

During the time spectators are present, the air in the theatre shall be kept continuously in motion by means of fans to the number of at least one to every 150 persons. Such fans shall be placed in positions remote from the inlet and outlet openings. No person shall be exposed to any direct draft from any air inlet. (C. O. Sec. 352e, subd. 3.)

Speaking of the situation, Commissioner George Bell remarked that about two months ago letters were sent out to every proprietor in the city, warning him to comply with the regulations, so that it cannot be said that this matter has been sprung upon them. The trouble with most of these proprietors is that while they have every facility for keeping their theatres pure and fresh, they will not use them. If the proprietors could only be made to see that it is not only a matter of meeting the requirements of the law, but of good business as well, there would be much less reason to complain of the condition of the theatres in general.

The Exhibitors' Reply.

Voicing the attitude of the proprietors of motion picture houses, Lee A. Ochs, president of the local branch of the Motion Picture Exhibitors' League of America, declares that the use of ventilating fans is almost an impossibility in cold weather. In a letter on the subject he states: "There are many reasons why it is not possible to continuously have in operation the exhaust or ventilating fans during the winter months, as far as the motion picture theatres are concerned.

"It may surprise you, but it nevertheless is a fact, that instead of the complaint coming from the authorities as to the non-operation, our greatest complaint comes from our patrons when we do operate the fans.

"You, no doubt, readily understand that the tastes and opinions of people assert themselves regarding places of public assemblage and amusement, as well as in the other things which go to make up our every day life. If we open a window somebody says, 'Close it;' if we close the window, somebody says 'Open it,' and if we start the fans we are told there is a terrific draft. In fact, we receive more complaints when the fans are in operation than we do at any other time.

"These fans are very powerful affairs, and there is no question but that they do create a powerful draft when in operation, and the complaints have been many in the theatres which I am interested in, and also in the theatres of the members of our organization that many dangerous and troublesome colds, backaches, muscular pains, etc., have been brought on through the drafts pounding upon backs, heads and other parts of the body of our patrons while our fans were in operation.

"You understand, however, that regardless of the drafts, or the sickness which we are liable to bring upon our patrons and public, we will always continue to comply with the law.

"At the same time you will see that especially during the winter months, although we have kept the fans in operation, the routine is absolutely unnecessary. These fans are not needed in winter time, as the air is clear enough; it is during damp and warm weather that the air becomes foul."

LEGAL DECISIONS

Steam Heating Properties.

In an investigation of the rates, service, rules and regulations of the Colorado Springs Light, Heat & Power Company, the Colorado Public Utilities Commission finds that the present fair value of the company's property in use and useful in the sale of steam heat is $122,774. It further finds that there is an annual deficit, which includes $8,000 annual depreciation reserve, in the sum of $13,912.

The laws of Colorado pertaining to public utilities and the regulation thereof by the Public Utilities Commission of the state enumerate by name all public utilities which shall be under the jurisdiction of the commission, and the commission is of opinion that it is without jurisdiction in the regulation of the sale of steam heat.

Agency for Wife in Contracting for Heating Installation.

Action was brought to recover for materials and labor furnished in putting a heating furnace into the defendant's house under a contract therefor made by her husband, to whom the plaintiff gave credit, supposing him to be the owner of the property. At the time, the defendant was away from home in a hospital. The foundation of the action was the claim that the husband was the wife's agent in the transaction. It was held that the fact that the husband had charge of the farm, that carpenters who had made repairs were employed by him, that he seemed to be in charge of the repairs, that the wife was there while the work was going up, that he had hired workmen for other improvements, and that the wife had paid them with her checks, some of which had been made out by him, that he had employed carpenters for repairs on the house and had given general instructions therefor, were admissible on the issue of his agency for his wife. The evidence was held to support a jury's finding that the husband was the wife's agent in having the furnace put into the house and judgment for the plaintiff was affirmed.—Lunge vs. Abbott, Maine Supreme Court, 95 Atl., 942.

Damage to Boiler Shipped—Evidence.

A cast-iron heating boiler shipped from St. Paul to Waseca by train, transferred from the train by dray and lowered into a basement, and there installed, was found, after installation, when water was put into it, to be cracked. The crack was variously described as from 2 in. to 6 in. long, and wide enough to allow of the insertion of a thin knife blade. The evidence was that it was carefully handled after it was taken from the train, and received no jars or jolts, but there was evidence that such boilers crack very easily, and there was no positive evidence that it was not cracked while so handled. The evidence was not conclusive that the damage occurred while on the train, and the rule that, when goods are delivered to a carrier in good condition and arrive at destination in damaged condition, a prima facie case of liability is made out did not, as a matter of law, apply. The jury, the Minnesota Supreme Court held, might infer from all the evidence that the boiler was damaged in handling after it left the train, and the case was not one for the application of the rule that testimony uncontradicted and unimpeached cannot be disregarded.—Lewes vs. Minneapolis & St. Louis (Minn.), 156 N. W., 6.

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Engineers in Get-Together Movement.

Forty-two national, state and local engineering and technical societies in the United States were represented at a conference on engineering co-operation which was held in Chicago, April 13 and 14, to bring about a closer relation among engineers and engineering organizations, to discuss ways to improve standards of engineering practice and to gain a clearer recognition of the engineer as a civic asset. Among the items discussed during the two-day session were the following:

1. Co-operation among engineering organizations. Is it desirable? In what way is it practicable?
2. Benefits of co-operation in securing greater efficiency in the larger matters of concern to the individual engineer, to the profession and to the public.
3. Methods of co-operation now in practice in various localities; results attained in Philadelphia, St. Louis, St. Paul and other places.
4. Various kinds of engineering societies and committees and the relative efficiency of their operations.
5. Relation of the specialized or exclusive national engineering societies to their local sections or branches and to the more inclusive local engineering society or club.
6. Result of co-operation in securing wider diffusion of knowledge on engineering subjects, as illustrated at Cleveland and elsewhere.
7. The engineering profession as a whole in its present condition as regards public esteem.
8. Reasons for decline in attendance at engineering colleges. Is it indicative of healthful conditions or of proper methods of education?
9. Employment; methods and results as practised by various engineering societies; an exchange of ideas.
10. Legislative activity, proper limits to be set, dangers to be avoided and needs of more systematic and better directed efforts.

At the conclusion of the conference a resolution was unanimously passed providing for the development of a plan for promoting co-operation among engineering societies upon matters of general interest to the engineering profession and to present such a plan at a later conference. F. H. Newell, professor of civil engineering of the University of Illinois, who, with C. E. Drayer, secretary of the Cleveland Engineering Society, were in charge of the meeting, was appointed the chairman of the committee to draw up a co-operation plan. In the preamble of the resolution it was noted that the rapid increase in engineering activity of recent years has given rise to many problems vitally affecting the practice of engineering and that the existing agencies lack proper correlation for the solution of these problems.

The American Society of Heating and Ventilating Engineers was represented at the conference by John F. Hale, of Chicago, former president of the society.

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Government Co-Operation With the Trade Press.

A more complete co-operation between the trade press and the Bureau of Foreign and Domestic Commerce of the Department of Commerce, is urged by Dr. Edward Ewing Pratt, chief of this bureau. "We are both going in the same direction," he said. "The Bureau and Department are endeavoring to build up the commerce of the United States, and I have found that the trade papers are not only honestly trying to build up their respective industries, but are succeeding nobly. I believe that the trade papers are the most effective agencies for trade promotion and industrial betterment that exist."

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

The Society's Summer Meeting.

As announced last month, the midsummer meeting of the American Society of Heating and Ventilating Engineers will be held in Detroit, Mich. The dates selected are July 19-21, 1916. The newly formed Michigan Chapter will be the host on this occasion, and preparations are going forward to make the meeting a notable one in the history of the society.

April Meeting of Illinois Chapter.

A talk on "Refrigeration and the Cooling of Air in Connection with Ventilation," was given by Thomas C. McKee, of the Carbondale Machine Co., of Chicago, at the April meeting of the Illinois Chapter. The address followed the usual chapter dinner at the Morrison Hotel, Chicago, April 10. Mr. McKee explained the character of the problems that come up in connection with the design of refrigerating apparatus and showed the similarity of refrigerating to heating problems. After the discussion which followed his talk, the chapter was addressed by Benjamin Nelson on the use of air washers for cooling air.

At the business session of the chapter, John F. Hale, Samuel R. Lewis and Dr. E. Vernon Hill were appointed a committee to represent the chapter at a meeting of delegates of various engineering bodies, called for April 13 and 14, in the rooms of the Western Society of Engineers in Chicago. The purpose of the conference was to devise a plan of co-operation between the different engineering societies for the mutual benefit of their members, both educationally and practically.

Annual Meeting of New York Chapter.

A plan was successfully inaugurated at the April meeting of the New York Chapter, held April 24, at the quarters of the Building Trades Employers' Association, in having the details of the program placed in the hands of a special committee. It is proposed to have a different committee for each meeting and in that way secure as wide a co-operation as possible among the members in arranging the programs. The April meeting was planned by a committee headed by P. H. Seward and proved one of the most entertaining ever held by the chapter. The two speakers were R. S. Elberty, of the New York State Compensation Inspection Rating Board, who spoke on "Safety First," and H. DeB. Parsons, who gave an illustrated talk on "Engineering Fallacies."

Mr. Elberty gave many instances from his personal experiences in which accidents occurred that could easily have been prevented and offered many suggestions in the way of "first rules" for avoiding accidents, not only in industrial work, but in the everyday habits of people generally. He cited one question that is put up to factory owners by the insurance rating boards in determining the ratings. This question is: "Is the ventilation sufficient to carry off all poisonous gases and dust?" Where the answer is "good," Mr. Elberty said that a reduction of 1% was made in the rate, and where the answer is "poor" an increase of 1% is made. This, he added, often amounts to a matter of $70,000 per year one way or the other in the rating.

After referring to the losses reported in the present European war, he said that equally significant figures could be reported in connection with the industrial life of America. The factory losses each year, for instance, in killed is no less than 30,000 and the number wounded during the same period is 700,000.

Mr. Parsons was then introduced and held the attention of the members for over an hour describing some of the more important engineering fallacies that had been offered at various times. He spoke first of the perpetual motion devices and showed several that had attracted more than the usual amount of attention. He then took up such schemes as the propelling of boats by jets of water and the use of water wheels for boats, the wheels being designed to ride the water very much as a vehicle travels on land. While many of these had some correct engineering theories back of them, there was almost always the unexpected development that interfered with the success of the schemes. With the boat on wheels, for instance, the presence of a water film on the wheels, as it revolved in the water, unexpectedly added to the power required, while the addition of a larger engine caused the boat to rest too low in the water.

Many so-called inventions also used correct engineering principles in the wrong way. For instance, the use of water jets in propelling a boat, he showed, was not dependent upon the jets being discharged into the water, as was incorrectly supposed, as their action would have been equally effective if discharged into the air. Yet for a long time it was thought that the jets acted as a rod pressing against the water and thus forcing the boat forward.

Other schemes shown by Mr. Parsons were various equipments of railroad locomotives for increasing either the speed or power, such as the use of driving wheels set on top of the wheels supporting the engine, all of which proved fallacies. He concluded his address with a description of the famous Keeley motor hoax which appeared in the '90's and which was only exposed after the death of the "inventor." It was then found that the innocent-looking wires that connected various parts of the motor were in reality hollow tubes filled with water at a high pressure operated by a hidden assistant and which were responsible for the seeming wonders performed.

At the business session of the meeting Treasurer William J. Olvany reported a balance in the treasury of $265.52. Secretary Frederick K. Davis reported that the present membership of the chapter is 79, of whom 75 are regular members. Ten new members have been added during the year.

The new officers elected are as follows: President, Arthur Ritter; vice-president, Frank K. Chew; secretary, Frederick K. Davis; treasurer, William J. Olvany. Members of the board of governors: W. H. Driscoll, Conway Kiewitz and C. E. Pearce.

The May meeting will be in charge of a committee, consisting of A. S. Armagnac, chairman; William D. Clark, George D. Farnham, A. M. Feldman, W. L. Fleisher, O. H. Fogg, R. B. Hunt, George W. Knight and George O'Hanlon. It will be held May 22, at the Building Trades Employers' Association.

Michigan Chapter.

A membership of fifty was reported at the first regular monthly meeting of the Michigan Chapter, which was held April 3 in the Fellowcraft Club, Detroit. Prof. John R. Allen, president of the chapter, gave a talk on "Heat Losses from Building Structures," and in the discussion which followed, the speakers included J. R. McColl, F. K. Boomhower, J. H. Walker and R. W. Davenport.

Reference to the proposed code of rules and regulations prepared by the Detroit Board of Health for the heating, ventilation and sanitation of motion picture theatres, led to an informal discussion of the requirements as drawn up.

The fact that the society started with a record of having submitted 37 applications for membership in the society is pointed to as a record that will be hard to equal. The appreciation of the society was quickly shown in the decision of the council to hold the semi-annual meeting of the society in Detroit, July 19-21.

It was arranged to hold the regular meetings of the chapter the first Monday evening in each month. The full list of officers is: President, Prof. John R. Allen; vice-president, Fred R. Still; secretary, William F. McDonald; treasurer, Edward M. Harrigan. Board of Governors: E. E. McNair, W. M. Foster and A. G. Pittelkow.

Eastern Pennsylvania Chapter.

Routine matters, including the adoption of the proposed constitution and by-laws, was the principal business transacted at the first regular meeting of the Eastern Pennsylvania Chapter, held at the Engineers' Club, 1317 Spruce Street, Philadelphia, April 13. A chapter dinner preceded the meeting.

Ohio Chapter.

A paper by E. A. Stark of the United States Radiator Corporation, was the principal item at the April meeting of the Ohio Chapter, his subject being "Chimneys and Draft." As it was not possible to have copies of the paper ready for the meeting it was voted to take up the subject again in the Fall, when the paper will be further discussed.

It is planned to have the May meeting a social gathering with a banquet, to be held in the Statler Hotel. Next Fall the chapter will hold its monthly meetings in the rooms of the Cleveland Engineering Society in the Chamber of Commerce Building.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Annual Convention to Be Held in Atlantic City.

It is announced that the twenty-eighth annual convention of the National Association of Master Steam and Hot Water Fitters will be held in Atlantic City, Wednesday to Saturday, June 21-24, inclusive, with headquarters at the Hotel St. Charles. This hotel has been recently remodeled and an extensive 13-story addition built in front directly facing the boardwalk.

The fact that the National Association of Master Plumbers is to hold its annual convention June 19-22 also at Atlantic City, at The Breakers (formerly the Hotel Rudolf) directly across the street from the St. Charles, will add greatly to the attendance and interest at both conventions, as well as provide the opportunity for co-operation of the two associations on projects in which both are interested, such as the separation of heating and plumbing from general contracts.

Local Association Formed in Youngstown Ohio.

A local association of master fitters, which is affiliated with the National Association of Master Steam and Hot Water Fitters, has been formed in Youngstown, O., with the following officers: President, C. J. Little; treasurer, T. G. Beede; secretary, Charles W. Wilson. Board of governors: C. J. Little, C. F. Henry and L. B. Scheible.

Newark (N. J.) Association.

Following are the officers elected at the annual meeting of the Newark (N. J.) Local Association, March 21: President, John Nellis; vice-president, John G. Kellar; treasurer, T. B. Cryer; secretary, Harry Geiser. Executive committee: Robert Berla (three years).

New York City Association.

New officers were elected as follows at the annual meeting of the New York City Association, held March 28: President, Joseph G. Geoghegan; vice-president, William H. Curtin; treasurer, J. E. Rutzler; secretary, Henry B. Gombers. Board of directors: Joseph G. Geoghegan, William H. Curtin, J. E. Rutzler, Michael J. Callahan and J. T. Dyas.

Massachusetts Master Fitters Hold Annual Convention.

Successful adjustment of a number of labor and similar problems was reported by President John E. Chatman at the annual meeting of the Massachusetts Association of Master Steam and Hot Water Fitters, which was held in Boston, April 3, at the Revere House. Among other things, President Chatman told of the negotiations that resulted in an increase of 25 cents per day in the wages of the helpers, making the minimum rate $2.75 per day. In regard to the matter of working rules it was settled that the agreement with the fitters amply protected the helpers.

"Up to the present year," continued President Chatman, "the steam fitters who have done work only on sprinkler systems and have been known as sprinklerfitters, have been a part of Local 537, and during the year the sprinklerfitters have withdrawn from 537 and formed a separate sprinklerfitters' union. We have written assurance, however, that the members of Local 537 will continue to perform the work of installing sprinkler systems.

"The question of the installation of vacuum cleaning systems which has been in dispute for two years, has recently been decided by President Alpine to be the work of either steamfitter or plumber.

"The local union of steamfitters and this association have always contended that this was the only just solution of the difficulty but it is doubtful it if would have been decided in our favor if we had not been organized.

"A committee of the association appeared before the State Board of Boiler Rules relative to inspection of boilers, asking for a more uniform interpretation of the rules by the inspectors. While the committee may not have accomplished immediate results, they feel that as an association we are in a stronger position for having frankly placed our case before them.

"Two matters have been considered by the association in connection with proposed legislation. Senate bill 48 was introduced by the union to make it necessary to obtain licenses by journeymen steamfitters and master steamfitters and in accordance with a vote of the association the officers were present at the hearing before the committee on mercantile affairs to oppose the passage of the bill.

"Senate bill 64 for the separation of contracts was introduced by the State Master Plumbers' Association and your officers appeared in favor of it at the hearing before the same committee. Leave to withdraw is the committee's recommendation, and the bill probably will be defeated.

"As a result of a discussion at the regular meeting in May, a special committee was appointed to prepare a standard estimate sheet for the use of the members. After extensive study and discussion at meetings, your committee prepared and had printed a sheet that they feel will be a great assistance in accurately making up estimates."

The new officers are: President, Frank Howard; vice-president, Frank Merrill; treasurer, Walter Ross; secretary, Herbert A. Snow. Advisory board: Frank Cleghorn, J. W. Woodward, Laurence Franklin, David Huey and John E. Chatman.

It was unanimously voted to change the name of the association to the Boston Association of Master Steam Fitters.

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The eighth annual meeting of the American Institute of Chemical Engineers will be held in Cleveland, O., June 14-17, 1916.

NATIONAL DISTRICT HEATING ASSOCIATION

Arrangements for Eighth Annual Convention.

Arrangements are now complete for the eighth annual convention of the National District Heating Association, which will be held in New York City, Tuesday, Wednesday, Thursday and Friday, May 16-19, inclusive.

Headquarters will be at the Hotel Martinique where a large part of the second floor will be given over to the uses of the association. Directly adjoining the assembly room will be an exhibition hall, and additional exhibits will be shown in the corridor leading to the assembly room. The program for the professional sessions is as follows:

First Session, Tuesday, May 16, 10.30 A. M.

Welcome address.

Response, Byron T. Gifford.

Report of executive committee.

Election of new members.

Address of President David S. Boyden.

Report of Secretary-Treasurer D. L Gaskill.

Appointment of nominating committee.

Report of publicity committee, D. L. Gaskill, chairman.

Report of underground construction committee, H. A. Woodworth, chairman.

Second Session, Tuesday, May 16, 2.30 P. M.

Report of nominating committee.

Paper, "Factors in the Growth of District Heating," by S. Morgan Bushnell.

Report of station operating committee, Byron T. Gifford, chairman.

Third Session, Wednesday, May 17, 9.30 A. M.

Address, "District Heating and Its Relation to Electric Utility Operation," by Arthur Williams, New York City.

Report of educational committee, George W. Martin, chairman.

Election of officers.

Fourth Session, Thursday, May 18, 9.30 A. M.

Paper, "Co-operating with Consumer," by Wm. J. Baldwin, Jr., New York Steam Co.

Address, "Appraisals of Utility Property," by M. F. Millikan, American Gas & Electric Co.

Report of rate committee, A. E. Bettis, chairman.

Fifth Session, Thursday, May 18, 2.30 P. M.

Report of publication and editorial committee.

Paper, "Ratio of Economizing Coils of the Different Types of Heating Systems," by W. J. Kline, New York City.

Report of record committee, A. P. Biggs, chairman.

Paper, "Methods by Which Harvard University Buys Steam on a Heat Unit Basis," by E. G. Bailey, Boston, Mass.

Sixth Session, Friday, May 19, 9.30 A. M.

Report of meter committee, F. B. Orr, chairman.

Address by Travis H. Whitney, Public Service Commissioner, New York City.

Report of delegates to Pan-American Congress, Jas. A. Donnelly, New York City, and Nelson S. Thompson, Washington, D. C.

Entertainment Program.

The entertainment program will be in charge of a general committee, composed of George W. Martin, C. A. Gillham, E. F. Tweedy, J. G. DeRemer, C. N. Greene, R. P. Bolton and C. R. Bishop. On Tuesday, May 16, the opening day of the convention, there will be an automobile ride for the ladies to Long View, where tea will be served.

On Wednesday afternoon, May 17, a boat ride has been arranged on the Nassau around Manhattan Island, with possibly a sail past the Palisades and down the lower bay. The boat will start from the Long Island Railroad pier at the foot of East 34th Street, immediately after the close of the morning session. A buffet luncheon will be served on board. It is expected the trip will be over by 6 P. M.

Thursday morning a party will visit the Metropolitan Museum of Art and in the afternoon the ladies will be the guests of the committee at a performance at the Hippodrome.

The association banquet will be held in the evening at the Hotel Martinique. On the conclusion of the dinner, a lecture will be delivered by Reginald Pelham Bolton on "Revolutionary Relics on Manhattan

Island." The hall will then be cleared for dancing.

Friday is open, with possibly a trip to Chinatown.

The chairmen of the various sub-committees are as follows: Exhibit, H. T. Luscomb; automobile ride, C. A. Gillham; boat ride, George W. Martin; art museum and Hippodrome, H. C. Spaulding; banquet, A. S. Armagnac.

Central Station Heating Notes.

Cleveland, O.—An advance in the municipal steam heating rates will be necessary to make the Cleveland municipal heating plant on Fairmount Road self-supporting, according to the recommendations of the commissioner of accounts. The rates were advanced last year from 30 to 35 cents per 1000 lbs., and the present recommendation is that they be advanced to 45 cents.

Hodenpyl Hardy Co., New York, announce the appointment of H. R. Wetherell as the company's steam engineer. Mr. Wetherell will have general supervision of the company's many plants in different sections of the country. He will make his headquarters in New York. Mr. Wetherell is a former president of the National District Heating Association ad was for 12 years superintendent of the heating department of the Central Illinois Light Co.

American District Steam Co., No. Tonawanda, N. Y., announces that H. A. Woodworth, formerly of the Merchants Heat & Light Co., of Indianapolis, Ind., is now connected with the American District Steam Co. Mr. Woodworth is succeeded in the Merchants company by C. J. Cooper, Jr.

Martin & DeRemer, New York, is the title of a new engineering firm composed of George W. Martin, formerly of the New York Service Company, and Jay Grant De Remer, until recently manager of the engineering department of the American District Steam Company. The new firm, which has taken quarters at 100 Broadway, New York, will specialize in utilities and industrial plant work. Mr. Martin is a graduate of the Stevens Institute of Technology. He will still retain his interest in the New York Service Co. Mr. DeRemer is a graduate of the University of California and previous to his going with the American District Steam Co., was vice-president and later chief mechanical and electrical engineer for the United Light & Power Co., of San Francisco.

Madison, Wis.—The United States Supreme Court will be called upon to pass upon that portion of the public utility law which permits a city to purchase the existing utility in a city even though it be but a segment of a large plant. The question arose in the case of the city of Menasha, which has attempted to purchase the property of the Wisconsin Light, Heat and Traction Company, within the confines of the city. The company which operates in Menasha also operates in several other cities, and the portion of the plant in Menasha is on a small segment.

Traer, Ia.—It has transpired that the new electric light company which is to operate in Waterloo is the Iowa Railway & Light Company of Cedar Rapids. The new interests have taken over the heating and lighting plant of F. L. White. The Iowa company holds franchises in many towns. Mr. White's franchise runs for ten more years and it is understood that it carries the steam heating service. It is reported that the new owners woud discontinue the heating service if they could. If not, the power plant in Traer will continue to be operated.

Ames, Ia.—The Iowa Railway & Light Co., owners of the Boone electric light and heating plant, has completed plans for the construction of a new $100,000 plant in Perry this summer. Perry is to be made the hub of the service in the towns in that neighborhood and the current will be sent to these towns by high tension wires. The old plant has been torn down and work on the new one has already commenced.

Grinnell, Ia.—The Iowa Light, Heat & Power Co., located at Grinnell, has announced its intention of putting in a new plant at a cost of $100,000. The present buildings, which have been in use for 30 years, will be retained for storage purposes and the new building will go up on the next lot south. This company has transmission lines to Brooklyn, Malcom and Kellogg, with the prospect of further extension in the near future.

Osage, Ia.—The Osage Electric Light, Heat & Power Co., has submitted a proposition to the city council asking for a renewal of its franchise which will expire in eighteen months. The new franchise calls for a revision of rates, making them conform to the rates in Charles City, Hampton and other towns in which the electric lighting plants are owned by an eastern corporation. It is understood that if the franchise is granted the Osage plant will also be taken over by the eastern corporation.

Sleepy Eye, Minn.—A proposition of installing a central station heating plant in Sleepy Eye has resulted in a subscription of $15,750 being raised toward the project to date. A committee composed of J. L. Kiefer, Frank Scobie, Charles Baugatz and L. A. Larsen of St. Paul, has been interviewing the citizens on the project with the result that considerable interest has been aroused and subscriptions secured to the amount stated. An organization was later perfected with J. L. Kiefer as president and Frank Scobie, secretary, and W. W. Smith, Hans Mo. and William Brust directors. Mr. Larsen has been commissioned to draw up the necessary plans and specifications, the idea being to have the plant ready by next fall.

Spokane, Wash.—According to D. P. Reid, secretary ,of the Public Welfare League, nearly 2,000 names have been turned in up to the last of March in the referendum against the steam heating and lighting franchise granted to Fred B. Grinnell. It is estimated that enough additional names will shortly be secured to make the referendum effective. As announced in recent issues, the Grinnell interests have been seeking a franchise in Spokane for some time, although the Merchants' Central Heating Company is already in the field. The Merchant's Company has not only made extensive plans to supply heating service in the city, but is also arranging to enter the electric field September 1. For the necessary equipment to furnish both services upwards of $1,000,000 is being invested by the Merchants' company. Contracts for the delivery of steam heat have already been closed for 38 buildings and connections have already been made to 17 of these.

Des Moines, Ia.—The proposed heating franchise in favor of the Des Moines Electric Company has been rejected by the voters of that city. The franchise was opposed by the Labor League of Des Moines which made a house to house canvass on the proposition. At a convention of the United Mine Workers of America, District No. 13, held previous to the vote, a resolution was passed to the effect that the measure would mean the loss of permanent employment of from 700 to 1,000 laboring men in Des Moines. On the other hand, the franchise as proposed received the endorsement of the Greater Des Moines Committee, the Des Moines Commercial Association, the Chamber of Commerce, the smoke abatement commission, the mayor and other city officials and many business men. It was, of course, reviewed and passed by the city council and submitted by that body to the electors of the city for ratification. In addition to the opposition of the labor men, there was some opposition on the part of certain business men who saw in the application of the franchise an endeavor by the electric company to secure an over-lapping contract with the city under which it might continue serving the city with electric power after its present light franchise expires in 1919. The service would only have affected the downtown district, as only the portion of the city bounded by Second, Court, Mulberry, Tenth and Pleasant Streets would have been reached by the system. The Des Moines Electric Company is operated by the McKinley interests of Illinois. The McKinley interests are controlled by the Sun Insurance Company of Montreal, owned by Canadian, English and New England capitalists. Fred Buffe of Peoria, publicity manager for the McKinley interests, and Charles S. Bradshaw, attorney for the company, represented the company's interests in its efforts to secure the franchise.

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Correcting Water Troubles in Steam Radiators.

Referring to an item published in the January issue in the Consulting Engineer department on water troubles in steam radiators, a correspondent writes that he has had some experience with trouble of this kind and in each case he corrected the same by installing a swing check valve in the return line at the boiler.

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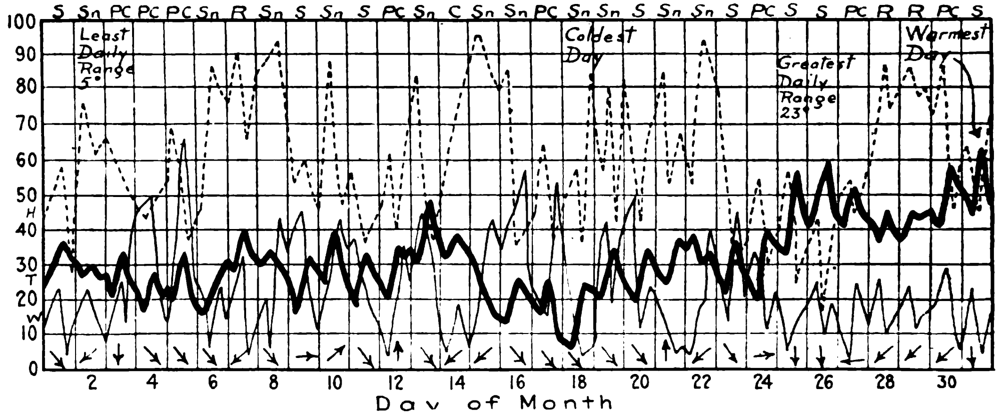
Industrial Arts Index of Technical Articles.

In connection with the indexing of trade and technical articles, our readers will be interested to know that the Industrial Arts Index, published by the H. W. Wilson Co., White Plains, N. Y., is a cumulative index of about 80 engineering and trade periodicals. All articles of any importance are indexed under as many subject-headings as the contents demand. The Industrial Arts Index is issued five times a year, in February, April, June, October and December, and each number is fully cumulated from the beginning of the year to date of issue. This makes it unnecessary to use any but the latest number at any time for a complete record for the year to date of issue. The subscription rate to the Index is based on the number of periodicals which each subscriber receives. Three annual numbers of the Index have been issued to date, covering 1913, 1914 and 1915.

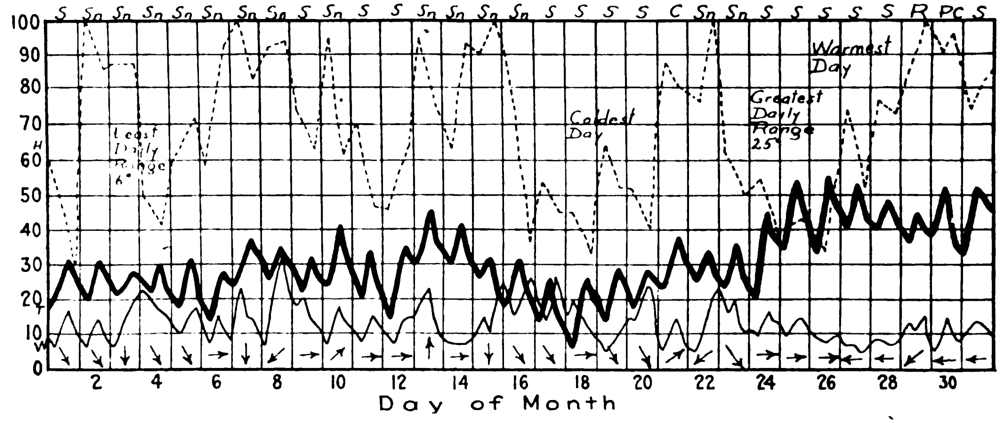
Among the periodicals regularly indexed is THE HEATING AND VENTILATING MAGAZINE.

The Weather for March, 1916.

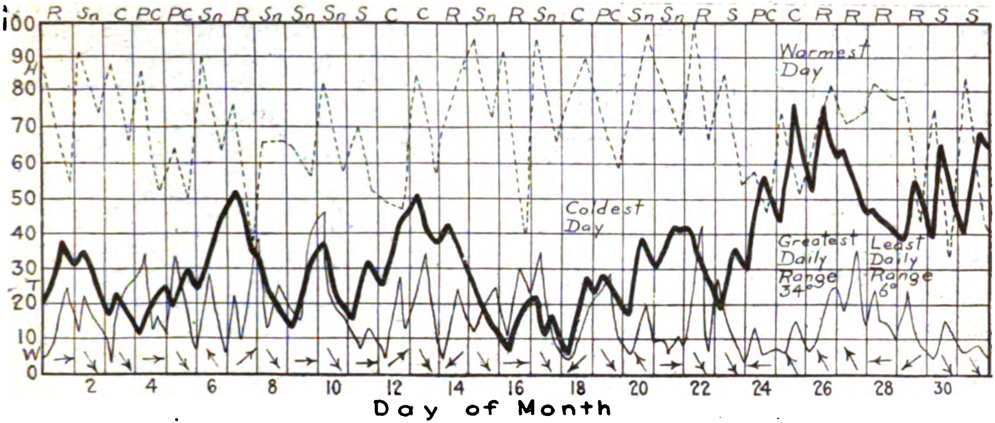
	New York.	Boston.	Pittsburgh.	Chicago.	St. Louis.
Highest temperature, degrees F	63	55	77	72	80
Date of highest temperature	31	26	25	25	13
Lowest temperature, degrees F	7	7	6	12	15
Date of lowest temperature	18	18	18	4	4
Greatest daily range, degrees F	23	25	34	32	48
Date of greatest daily range	25	24	25	24	22
Least daily range, degrees F	5	6	6	3	6
Date of least daily range	2	3	28	27	1
Normal temperature for month, degrees F	32	31	34	34.6	45.0
Normal mean temperature for month, deg. F.	37.5	35	39.5	34.4	43.5
Total rainfall, inches	3.71	3.2	3.63	2.48	1.83
Total snowfall, inches	25.5	33	11	5.5	9.4
Normal precipitation this month, inches	4.1	4.08	3.01	2.55	3.43
Total wind movement, miles	14,674	8,870	9,718	11,396	11,320
Average hourly wind velocity, miles	19.7	11.9	13.1	15.3	15.2
Prevailing direction of wind	N.W.	W.	N.W.	N.	N.W.
Number of clear days	8	16	7	7	12
Number of partly cloudy days	13	4	5	9	8
Number of cloudy days	10	11	19	15	11
Number of days on which rain fell	15	15	18	13	9
Number of days on which snow fell	11	14	9	5	2
Snow on ground at end of month, inches	..	..	..	..	..



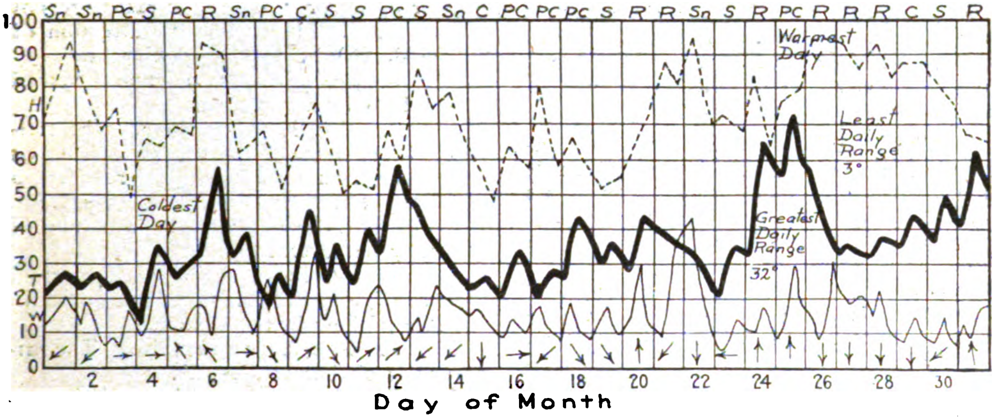
RECORD OF THE WEATHER IN NEW YORK FOR MARCH, 1916.
(Hourly Observations of the Relative Humidity Are Plotted on this Chart.)



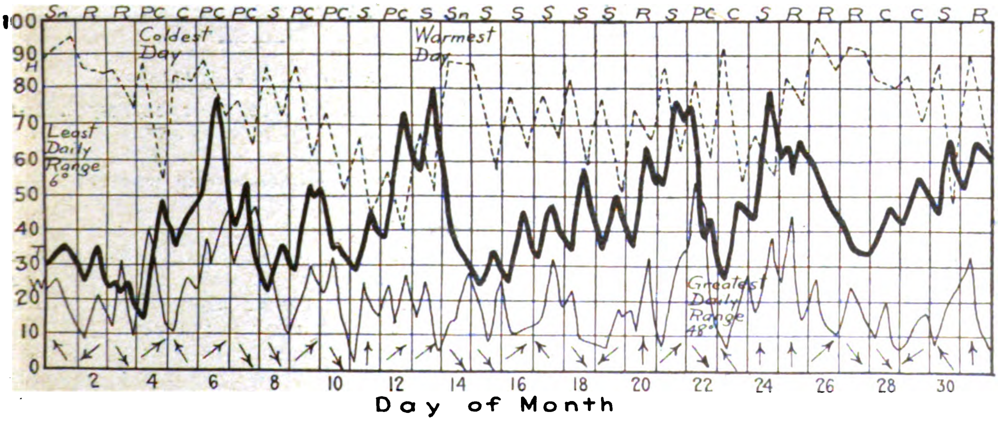
RECORD OF THE WEATHER IN BOSTON FOR MARCH, 1916.



RECORD OF THE WEATHER IN PITTSBURGH FOR MARCH, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR MARCH, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR MARCH, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

CORRESPONDENCE

Relation of Bernoulli Theorem to Heating and Ventilating Work.

Editor Heating and Ventilating Magazine:

Referring to the article in your February issue on "The Principle of Bernoulli and Its Relation to Heating and Ventilating of Buildings," I would call your attention to the following errors:

1. The principle (or theorem) of Bernoulli holds only for inelastic fluids, such as liquids to which water, etc., very closely approximate. Where, under changing conditions, internal work is done, the equation fails utterly. Such occurs in all gases to which, therefore, the Bernoulli theorem does not apply, as the internal change of energy must be taken into account.

2. The boat illustration (Fig. 3) is unhappily in error. The velocity on either side of a perfectly symmetrical boat at points equidistant from the bow will be equal. The divergence of the bow tends to force anything away therefrom, with reverse conditions at the convergent or latter part of the boat, this being increased by the suction effect of the propeller. There is no direct effect tending to force two boats together, the opposite being quite as common, but does not impress the mind as much as a collision.

The relation between two boats is quite complex, depending on relative velocities, size, distance apart, rate of wave propogation, lack of symmetry, etc. There is a tendency at the divergent part of a boat to force things away that are within its radius of influence, with reverse conditions at the convergent part, the water no longer being at rest, nor the surface flat.

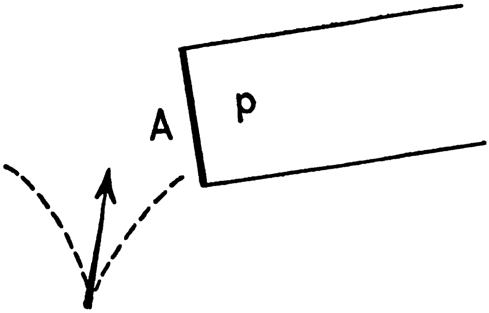


FIG. 1.

3. Relative to the effect of wind on a heating system, there is none on a closed system, such as a steam or hot water system. On an open system, as with hot air, the effect may take place at either the inlet or outlet or both. Four cases present themselves (W) indicating the direction of the wind, (A) being the opening, and (p) the relative pressure (plus or minus) caused by the heat in the system.

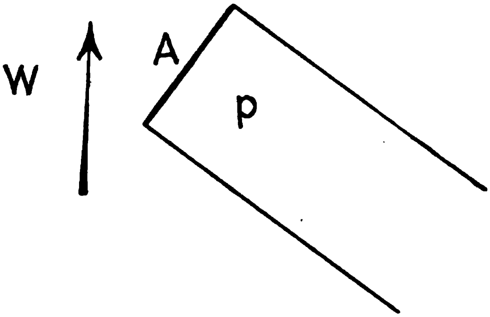


FIG. 2.

Case A. Fig. 1, (p) positive. The tendency here is to divert the streamline of (W) away from (A), causing by reaction, a throttling effect on the heating system. With (W) great enough, the direction of flow may be reversed.

Case B. Fig. 1, (p) negative. The effect is reversed, and the tendency is to cause an increase of flow in the system.

Case C. Fig. 2, (p) negative. The influence is similar to Case A.

Case D. Fig 2, (p) positive. Similar to Case B.

Otto B. Goldman.

Portland, Ore.

REPLY BY S. R. WILLIAMS.

I would state that your correspondent does not seem to be conversant with the facts or with the literature concerning Bernoulli's principle. If he will read the article a second time he will note that I start off by carefully defining what is meant by a steady state of flow, which is the simplest case to consider. Secondly, the equation which I gave always applies to a fluid in which friction is ignored.

To say that the principle of Bernoulli does not apply to gases is incorrect and is a statement against the opinion of the best authorities. If the principle of Bernoulli does not apply to gases, can your correspondent state why the apparatus shown in Fig. 2 in my article works as well with a gas as with water?

The boat illustration which my critic calls attention to is an old stock illustration which he will find given in a very interesting article by W. S. Franklin in the Journal of the Franklin Institute for January, 1914, entitled "On Some Phenomena of Fluid Motion." If he has not two boats to try this particular experiment on, he can try the experiment proposed by Mr. Franklin, viz., to blow between two light balls which are suspended by long cords near each other. Not only will he discover that he always has a collision between the two balls but, in addition, he will find that the principle of Bernoulli applies to the gas which exhales from his mouth.

In "error 3" your correspondent seems to have completely misunderstood the article. I have not said there was any effect on a steam or hot water heating system as there is on a hot-air system. The air in the house, no matter how it is heated, will be sucked out by the principle of Bernoulli, and in the case of a hot-air furnace even the air which circulates through it may be caused to go in a reverse direction is my contention.

Cases A, B, C and D, which he cites, if I understand them, have nothing to do with the case which I considered. I discussed the problem where the stream lines of flow of air are made to converge between two houses, and when this occurs an aspirator effect pulls the air out through the cold air duct of a hot-air furnace, no matter at what angle it is set in the wall, though usually the opening to the cold air shaft is flush with the surface of the house past which the air is flowing.

In conclusion, if your correspondent will look up any advanced, up-to-date textbook of physics he will find much to interest him concerning the Bernoulli principle. An article by Bergen Davis in the American Journal of Science for September, 1900, will afford one other very interesting application of Bernoulli's principle to a gas.

I would consider it a great favor if your correspondent would refer me to the authorities on which he bases his arguments.

The Proposed Compulsory Requirements for Natural and Mechanical Ventilation of School Buildings.

Editor Heating and Ventilating Magazine:

I have read with a great deal of interest your report of the recommendations of the American Society of Heating and Ventilating Engineers relative to the heating and ventilation of buildings (April, 1916, issue). After a report has received the endorsement of such an eminent body of men of unquestioned ability, the very fact of my going so far as to question any part of it brings to mind the old saying, "Fools enter where angels fear to tread," and yet, if I may be pardoned, there is one portion of the report that appears to me as being unjust and misleading and, if after further consideration, such is found to be the fact, a correction should be made. I refer to Section 2, Article 9 (Gravity Indirect Systems).

If this article as a whole were to be placed before a body of legislators who are not acquainted with the facts, they could hardly come to any other conclusion than that natural ventilation, if it is possible to avoid it, should be barred from all school buildings, whether large or small. The effect of this article, as I interpret it, is to recommend that a law be passed enabling all pupils who attend a large school to enjoy the amount of ventilation the law requires, but the pupils attending smaller schools do not seem to be of as much importance, as they may be served by an inferior system that does not comply with the requirements for large school buildings.

I am surprised that the society should take such a position. It is a fact that mechanical ventilation can be installed in every school building built, either large or small, and if I were convinced, as the society seems to be, that it is the only means of meeting the requirements, I would recommend that it be installed in all school buildings. I would not recommend an inferior scheme for one building and a superior one for the other. If, on the other hand, I were convinced that both natural or mechanical ventilation could be installed to comply with the requirements, I would then recommend that either be used, but in either case the law must be rigidly complied with. It appears to me the position of the society is somewhat weak on this point.

I now draw your attention to the conditions the society recommends shall exist in school buildings at the time they are to be tested when natural ventilation is installed. The rooms are to be maintained at 70° F., the warm air entering the rooms is to be 40° above the outside air and under such conditions 30 cu. ft. of air per minute per pupil is to be delivered.

Now let us suppose we are testing a schoolroom under this recommendation. The temperature outside is zero; 1,800 cu. ft. of air per minute must be delivered into the room at not over 40°. This air must be reheated after entering the room to an even temperature throughout of 70° and then exhausted through the exhaust flues. I submit that with either mechanical or natural ventilation, with 1,800 cu. ft. of 40° air entering the room per minute, the down draft would be so intense that the pupils could not remain long enough to make the test. I submit further that no schoolroom in America has ever been operated under such conditions with any kind of a system of ventilation nor has any building ever been tested with such conditions existing. It would be uninhabitable, whether the air was delivered by a fan or with heat.

If the conditions mentioned in this article are the proper conditions to test any school building, why not specify the same conditions for mechanical ventilation, as well as natural? On the other hand, if these are not the proper conditions to test any school building, why recommend them as the ones that must obtain where natural ventilation is installed?

So far as our own practice is concerned, we neither favor nor condemn either mechanical or natural ventilation. We design both and are very particular that either must comply with the law, which is the same in other respects as the requirements recommended by the society. When our plants are completed, we always have the tests made by the superintendent of schools who is independent of contractors, architects and ourselves, and therefore the tests can be relied upon. From the few tests of school buildings having natural ventilation, which are enclosed herewith, I do not think the members of the heating engineers' society will regard that natural ventilation is unfit either for large or small buildings.

I would very much appreciate a statement from some member of the society explaining the meaning and reasons for the language employed in this article.

C. F. MIDGLEY.

Salt Lake City, Utah.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HEATING—

Electric Heating: Its Present Position and Future Development. George Wilkinson. Also discussion. Ills. 13 pp. I E E Jl—Jan., 1916. Apparatus for automatic temperature control. 20c.

HEAT LOSS—

Heat Loss Calculations. R. W. Noland, with discussion. 4000 w. Ind. Eng. Soc.—1915. Unreliability of methods. 20c.

HUMIDITY—

The Theory of Humidity. C. Harold Berry. 3500 w. S Jl E—Feb., 1916. Attempt to formulate consistent theory. 20c.

NEW DEVICES

A New Fluid Meter for Steam, Water and Gas.

The measurement of steam flow is one of the most difficult engineering problems that has ever been attempted. It resolves itself into two parts: (1) to obtain a pressure difference that varies in a known and definite manner with the rate of flow, and (2) to accurately measure, record and integrate the rate of flow by means of this pressure difference.

At first a great deal of experimenting was done with Pitot tubes and multiple hose nozzles, and many variations were tried in their design. In the experiments conducted by the Bailey Meter Co., of Boston, Mass., they proved to be very unreliable in all cases except in long runs of straight pipe, and even there the latter did not maintain its accuracy for any reasonable length of time.

After extended investigation, this company devised a special type of orifice which has proved to be an excellent means of securing the required pressure difference. It

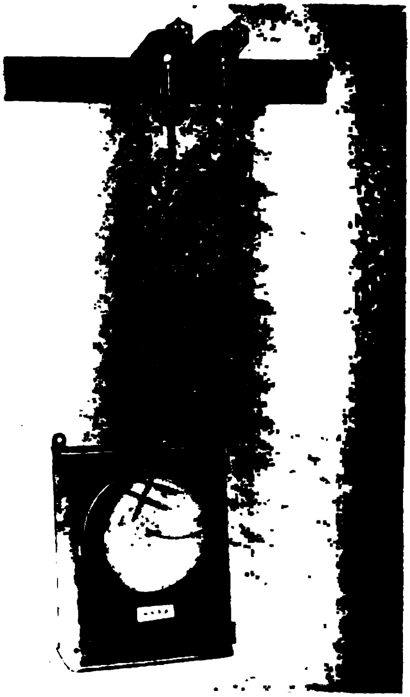


FIG. 1.—BAILEY FLUID METER ATTACHED TO A PIPE LINE.

has the advantage of low cost, easy installation, and of giving constant accuracy over long periods of time. The size of the orifice is suitably proportioned to the size of pipe and the meter capacity desired, so that the company's standard recorder can be used from the lowest to the highest velocities without changing the piping in any way.

The pressure loss caused by the orifice is never more than about 1 lb.

This meter works upon the principle of accurately measuring the pressure difference across an orifice placed between a pair of flanges in a pipe line, as shown in Fig. 1.

The special orifice plate used is made of 1/32-in. monel metal and is corrugated near its outer edge so that it forms its own gasket. The size of the orifice is proportioned to the size of the pipe, the quantity and density of steam or other fluid flowing through it, so that about ½-lb. pressure drop is secured at average rates of flow.

A sectional view of an orifice installed in a horizontal pipe is shown in Fig. 2. This particular orifice is of segment shape which is used in high velocity work so as to secure the correct pressure difference without undue obstruction. Circular orifices of relatively smaller diameter are used for lower capacities. In such cases a small drain hole is located in the orifice plate at the bottom of a horizontal steam pipe to prevent any accumulation of water

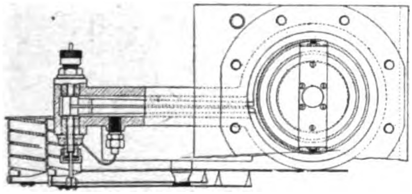


FIG. 2—DETAIL OF RADIATORS TO KEEP WATER LEVEL AND TO MAINTAIN EQUAL TEMPERATURES IN CONNECTING PIPES.

When metering steam it is necessary to have the bell casing and cementing pipes completely filled with water up to an equal and constant level. Each time the bell rises or falls some water is drawn down in one pipe and an equal volume forced up in the other. It is practically impossible to have large enough reservoirs on a level with the steam pipe connections to answer this purpose, but the radiators, shown in Fig. 2, consisting of a horizontal piece of ½-in. copper pipe with a number of washers or fins, serve to keep the water level and at substantially equal temperatures in the two connecting pipes.

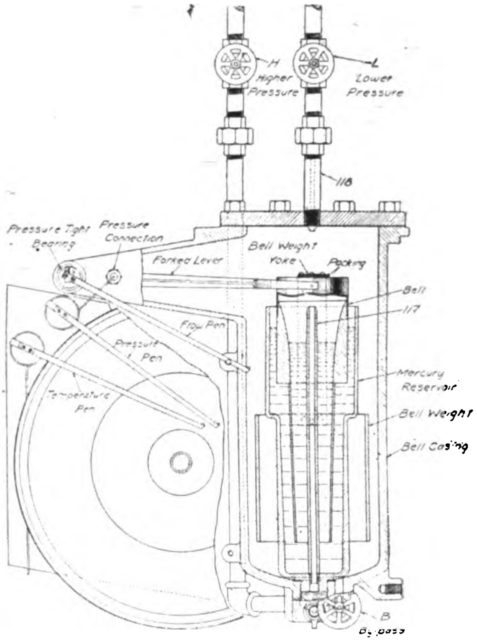


FIG. 3.—CONSTRUCTION OF BAILEY FLUID METER.

There are but two moving parts in the recording part of this meter. The pressure difference is applied to opposite sides of a special-shaped bell sealed in mercury, and this acts like a frictionless piston, using the buoyant action of the mercury on the walls of the bell to balance the force due to the pressure difference. The bell has a variable cross sectional area so that the recorder gives a reading which varies in direct proportion to the rate of flow, so that charts with uniform graduations are used and the records can be easily read and averaged or totaled with a Radiometer.

Fig. 3 shows in detail the construction and operation of the Bailey fluid meter, and applies to the main operating parts of Types C to C 4 inclusive. The higher and lower pressures from the up-stream and down-stream sides of the orifice are connected to valves H and L respectively. Valve B is a by-pass which serves to equalize the two pressures when desired. From Valve H., the higher pressure is conducted through pipe 90 and tube 117 to the space within the mercury-sealed bell. From Valve L, the lower pressure is conducted through tube 118 to the interior of the casing, which is subjected to full pipe line pressure of the steam or other fluid being metered.

The liquid shown in the reservoir is mercury and the entire casing and piping are completely filled with water at all times when used as a steam or water meter. The bell is entirely closed, except at its lower end, which is sealed by the mercury contained in the reservoir, so that the pressure H, applied through tube 117 to the space within the bell, which is in excess of the pressure L, applied through tube 118 to the space without the bell, tends to push the bell upward in proportion to the pressure difference.

The shape of the bell in this meter is designed in accordance with the actual flow curve corresponding to the pressure difference and rate of flow through the orifice, so that a direct reading chart with uniform graduations is used and the proper integrator motion is secured without adding to the friction or complexity of the mechanism.

New Type of Air-Seal for Hot Water Heating Plants.

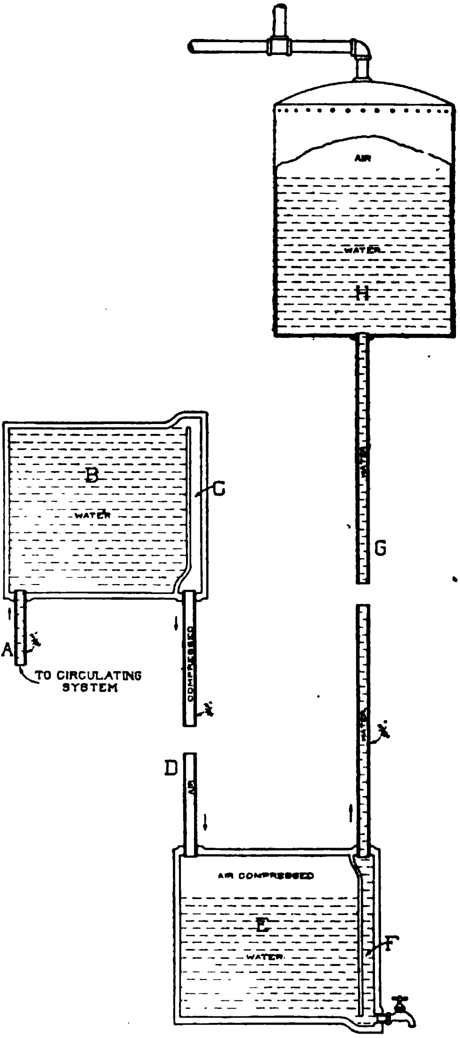
A new application of the principle of an air-seal for sealing the water in a hot water heating system from the atmosphere until a safe and predetermined low pressure has been produced, has been developed by M. C. Honeywell, inventor of the Honeywell line of heating specialties, and has just been placed on the market by the Honeywell Heating Specialties Co., Wabash, Ind.

By referring to the accompanying illustration, it will be seen that the generator consists of two simple castings, or partitioned chambers, called air separators. One is designed to be placed on the first or second floor and the other in the basement. One opening in the upper separator connects with the circulation system, while from the other opening in the upper separator, a pipe is dropped to an opening in the lower separator. Passing upward from the lower separator is a pipe extending to the expansion tank.

When the system is first filled, the cold water passes into the boiler and radiators and when these are full, enters expansion pipe A, forcing the air from upper separator B, into compartment C, and thence down air pipe D, which joins the two separators. When water fills chamber B, it passes over the top of the web into compartment C, down pipe D, into E. When this action takes place most of the air is forced down into the lower separator E, where it is effectively trapped at its top, due to the position of the web in this separator. As the water continues to flow, it passes into compartment F, up pipe G, and fills tank H, which action compresses the air trapped in lower separator E.

Instantly after the water is turned off and the flow stops, the air that is trapped and compressed in lower separator E, enters and fills air pipe D, and compartment C. Thus is established a differential between the air in pipe D, and the water in pipe G—this difference in weight equalizing approximately ½-lb. for each foot in height between the two separators. The action that takes place in the generator during filling, as above described, applies in like manner to its regular operation under normal conditions.

It is stated that it is impossible to dislodge or blow the air out of the generator under 100 lbs. water pressure when filling the system; neither is it possible for air



CONSTRUCTION OF HONEYWELL AIR-SEAL GENERATOR, SHOWING APPARATUS PRODUCING FULL PRESSURE.

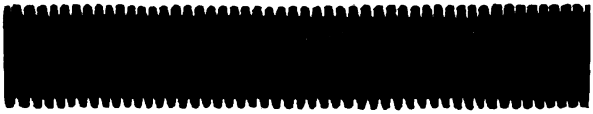
to be drawn from the upper separator into the system, when the water cools and contracts.

The generator is furnished in four sizes, two for plants containing 1,500 sq. ft. or less of radiation and for buildings of different heights, and two for plants containing 1,500 sq. ft. or more of radiation, also for buildings of different heights. The generator is the subject of a newly-issued circular giving complete information, including designs for typical installations.

◆

TRADE LITERATURE.

Sarco Temperature Control is the title of a new circular featuring the Sarco temperature regulators, made by the Sarco Co., Inc., now located in the Woolworth Building, New York. Special attention is called to the actuating part of these regulators, consisting of a thin, spirally-corrugated tube, which, it is stated, differs from every other appliance made for the same purpose.



SPIRALLY-CORRUGATED TUBE USED IN SARCO TEMPERATURE REGULATORS.

The metal is of special composition to secure elasticity, resiliency and unvarying quality. Although spirally-corrugated, the corrugations are not annular, so that when the tube is expanded or contracted, the movement is equal on every turn of the spiral. It is stated that there is no deterioration with this tube after many years of service. Attention is also called to the point that the Sarco spiral is the only tube which will permit the use of liquid as an expanding and contracting agent. This principle is applied in the Sarco tank and room temperature regulators, a special illustration being included, showing the operation of the regulator accompanied by the necessary descriptive matter. Size 6 x 9 in. (standard).

Vapor Talk, devoted to "common sense heating for comfort and economy," is a unique publication, recently issued by the Haynes Selling Co., 1711 Sansom St., Philadelphia, Pa. The publication is devoted to modulated and vapor heating, featuring the Haynes modulating valves, the Haynes thermostatic valves, the Haynes regulators and the Haynes air controllers. The greater part of the circular is taken up with general data on the subject of heating, running from "methods to determine the correct amount of radiation to be used" to systems of piping required, sizes of steam mains for direct radiation and similar tables. Size 3½ x 6 in. (standard). Pp. 32.

National Tube Company bulletins (Nos. 25 and 26) have been issued by the National Tube Co., Pittsburgh, Pa. Bulletin No. 25 is an elaborate publication, devoted to "National Pipe in Large Buildings." National pipe service is taken up in detail accompanied by brief statements of some of the advantages of this pipe. Considerable space is then given over to a discussion of steel pipe, with quotations from the leading authorities on its durability. An imposing array of buildings is shown in which National pipe is used and the remainder of the catalogue is filled with important miscellaneous data for the engineer. This bulletin, it is stated, is not intended for general distribution, but rather for architects, constructing engineers and large building contractors. Size 8½ x 11 in. (standard). Pp. 88.

Bulletin 26 is devoted to "Autogenous Welding of National Pipe," and contains an elaborate presentation of this subject, profusely illustrated. The different divisions of electric welding, blowpipe welding and thermit welding are all discussed, with many views of the welding processes being applied. The illustrations, which are mostly photographic reproductions of the various processes as used, number 88. Size 8½ x 11 in. Pp. 52.

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Seventieth Anniversary of Heating Firm.

More than 100 employees of the B. G. Carpenter Co., of Wilkes-Barre, Pa., were guests of the company recently at a dinner in honor of the seventieth anniversary of the company's organization. During the course of the evening the history of the B. G. Carpenter Company was brought out in detail from the early days of the business to its present position as one of the largest heating and plumbing engineering and contracting firms in Eastern Pennsylvania. It was stated that during the past year alone the company's sheet metal department has fabricated over 2,500,000 lbs. of sheet metal, used 150,000 ft. of steel angle-iron, 20,000 bars of solder and over 3,000,000 rivets. About 400 carloads of material have been handled over the Carpenter switch in the year's time. A large part of the success of the company, it is stated, is due to the efficient service of its engineering staff, composed of W. E. Pulverman, O. A. Vincent, A. L. Sanford, D.

P. Carter and H. F. Bantham. The officers of the company are: President, B. H. Carpenter; secretary and treasurer, J. Ed. Wilson.

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Unique Industrial Exhibition in Jersey City.

Instead of grouping the exhibits in any one hall or building, the manufacturers and retail merchants of Jersey City, N. J., who are co-operating in an industrial exhibition of Jersey City made goods, to be held June 5-10 next, are planning to have each retail merchant turn his store into a show room for some particular manufactured article, which is made in that city and which he can commercially handle.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, published monthly at New York, N. Y., for April 1, 1916.

State of New York, }
County of New York, } ss.

Before me, a notary in and for the State and county aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York.
Editor, A. S. Armagnac, 1123 Broadway, New York.
Managing Editor, None.
Business Manager, Gustave Petersen, 1123 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock).
Heating and Ventilating Magazine Co., 1123 Broadway, New York.
A. S. Armagnac, 1123 Broadway, New York.
Gustave Petersen, 1123 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:
None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 21st day of March, 1916.

(Seal) A. L. SCANTLEBURY, No. 173.
Notary Public Kings County. Certificate filed in New York County.
(My commission expires March 30, 1917.)

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JUNE, 1916

Natural Ventilation in the Federal Hill School

An Unusual Combination of Window Air Inlets, Excessive Radiation and Exhaust Flues.

BY HAROLD L. ALT.

Those interested in the heating and ventilating of public schools will find the system recently installed in the Federal Hill School at Bristol, Conn., deserving of more than passing notice. The original building was heated by direct radiators, supplemented by indirect stacks which also supply air for ventilation purposes. The system in the old building was purely a gravity one and not very satisfactory, requiring considerable steam pressure to circulate. When the new addition was erected, a view of which is shown in Fig. 1, an effort was made to improve on the older installation, this finally developing into a method of heating and ventilating following closely upon the ideas carried out in the Fairfield School, in New Haven.

The system finally incorporated was more or less experimental in nature, and consists briefly of two exhaust flues for each class room with registers about 8 feet above the floor. All the fresh air for the class rooms is obtained by the opening of the windows at the bottom where adjustable glass deflectors are placed so as to prevent drafts blowing directly on the pupils. In order to allow a sufficient quantity of air to enter for satisfactory ventilation, without undue cooling, the radiation was arbitrarily increased from the normal amount usually installed to the quantities shown on the basement, first and second floor plans given in Figs. 2, 3 and 4.

THEORY OF INSTALLATION.

The theory of the installation is that the cold air entering through the lower part of a partially-opened window is deflected toward the ceiling both by the ventilator and the upward current of hot air from the enormous radiators. The hot and cold air currents mix during the upward passage, thus producing a modified temperature of about 70° F., this tempered air falling backward toward the floor and onto the pupils' heads. Having become slightly heated by contact with the human element in the room, the contaminated current tends to rise again toward the vent registers, the air finally leaving the rooms by way of the two exhaust flues.

FIG. 1—FEDERAL HILL SCHOOL.

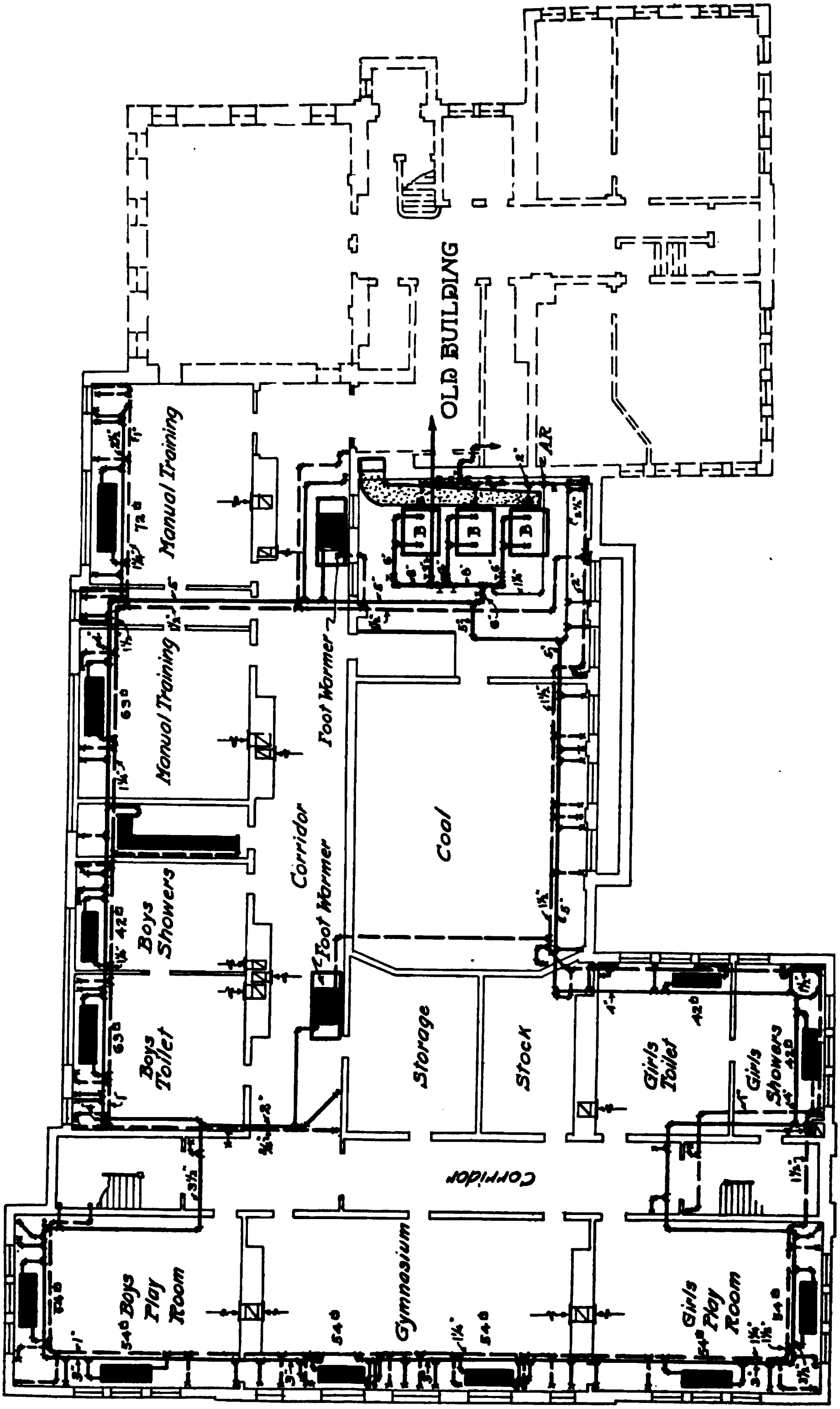

FIG. 2—BASEMENT PLAN, FEDERAL HILL SCHOOL.

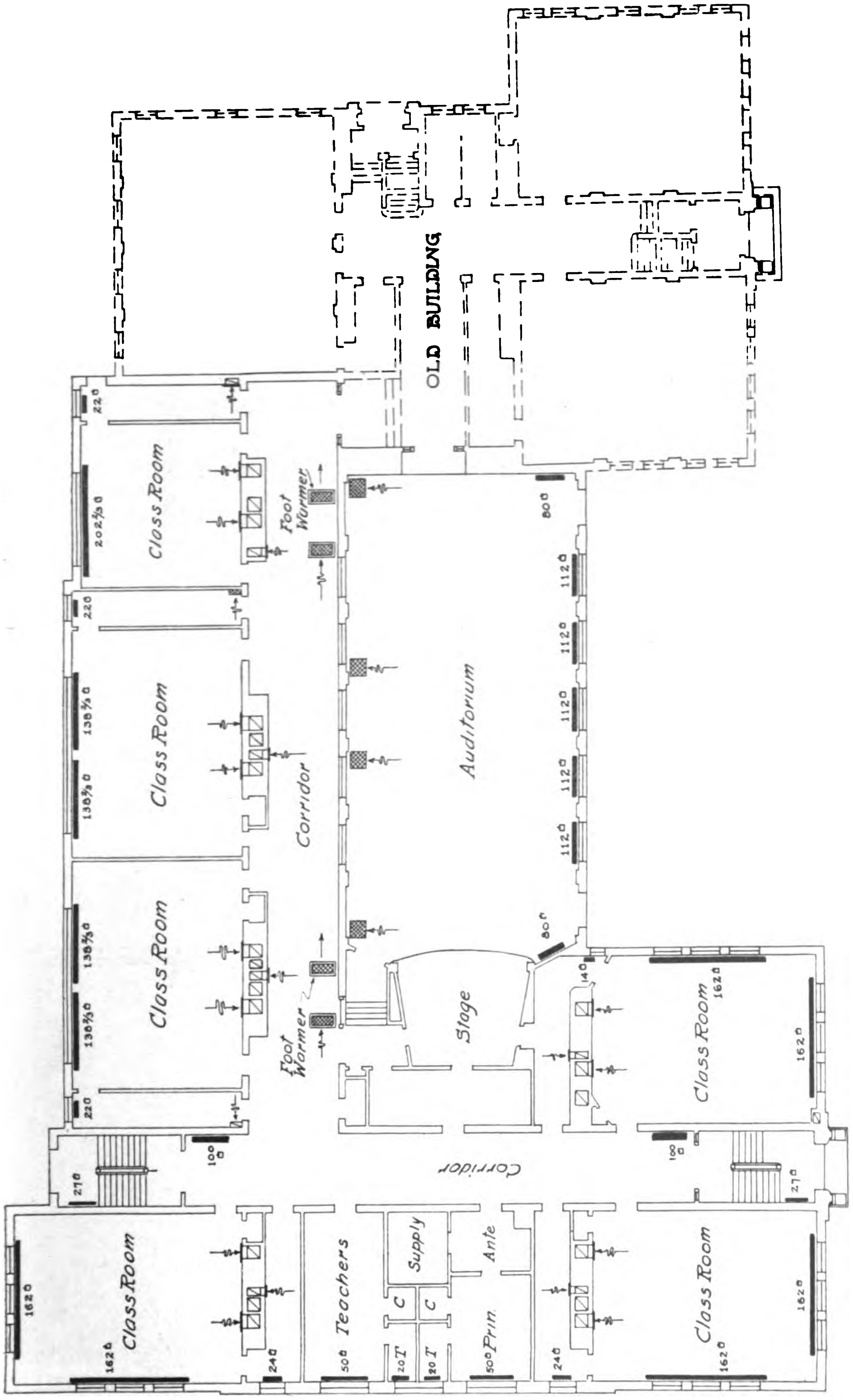

FIG. 8—FIRST FLOOR PLAN, FEDERAL HILL SCHOOL.

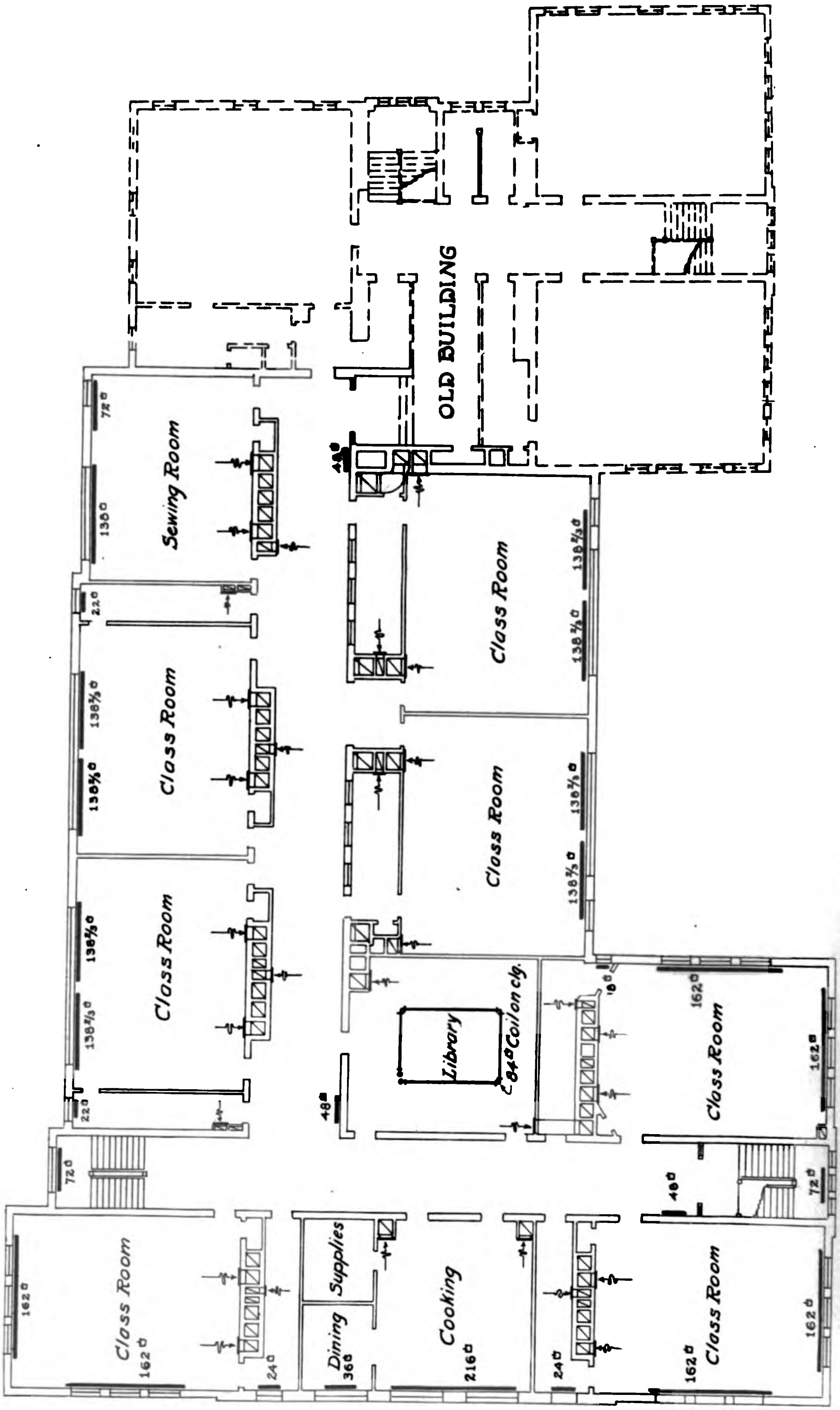

FIG. 4—SECOND FLOOR PLAN, FEDERAL HILL SCHOOL.

This method involves the problem of controlling large radiator units so as to prevent discomfort to the pupils sitting beside them, and the supplying of sufficient heat in the rooms to allow ventilation in extreme weather. Rooms on the windward side must also be protected from excessive drafts between the windows and the exhaust registers, caused by the outside wind pressure.

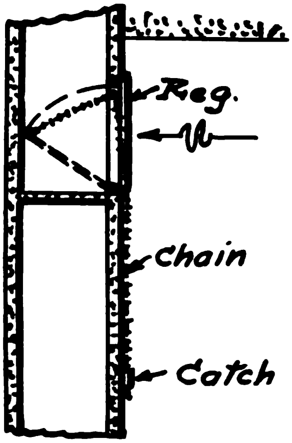

FIG. 5—DETAIL OF EXHAUST OUTLET.

The draft proposition was successfully overcome by using adjustable dampers in the exhaust registers operated by chains, these being shown in Fig. 5, and located in general as shown in Fig. 5a, while the radiators were placed on a modulated steam system with graduating valves on the supply and traps on the returns. In general American Radiator Company's Peerless radiators, 26 in. high, legless and wall hung, were used, the supply and return valves being of Thermograde manufacture.

At first it was thought that radiator shields would be required, owing to the large amount of surface, but the modulation system has been so satisfactory that the shields have not proved a necessity. Their use, however, would undoubtedly be an improvement, though there was only *one* teacher in the building who thought the children were uncomfortable at times on account of the close proximity of the large heating surfaces.

For one who is familiar with many schools where all sorts of ventilating systems are in use, including gravity systems, etc., the sensation of entering the Federal Hill School is novel. There is a "fresh" smell and a total lack of the well-defined "school" odor so common where simply a fan system of 30 cu. ft. per minute per pupil is the basis of air change. This "freshness" may perhaps be deceiving and may be only the result of getting a certain amount of cold and untempered

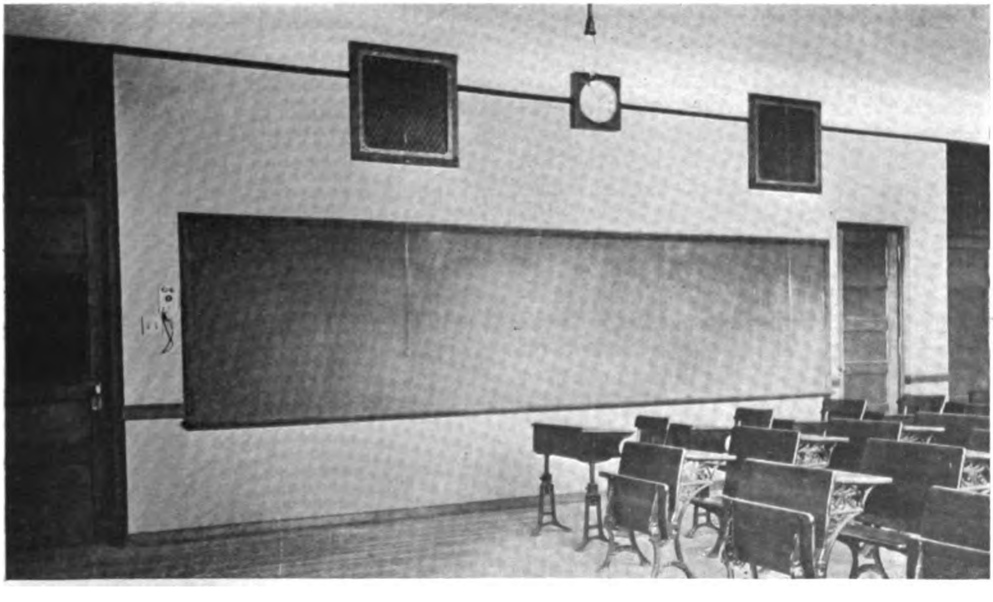

FIG. 5A—VENT OUTLETS IN CLASSROOMS, FEDERAL HILL SCHOOL.

air into the rooms, but whatever the cause the pleasant effect is there.

DETAILS OF EQUIPMENT.

In the boiler room three H. B. Smith Company No. 44 twelve-section Mills boilers are installed, one being for the old section and two for the new building. The valving is arranged so that either one of the two end boilers can be operated entirely independently of the others and at the higher pressure necessary to be maintained on the old system.

On the new building modulation system all the returns are carried to a Van Auken alternating receiver AR (Fig. 2) and are then connected to the boiler return, with a vent run to the chimney, all as shown in the diagram of connections, Fig. 6. The receiver is set midway between the water line of the boiler and the level of the main return from the building.

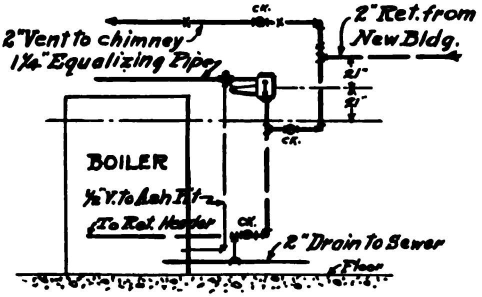

FIG. 6—ALTERNATING RECEIVER CONNECTION.

Drips on the supply mains are carried through water seal valves into the return mains, as indicated in the detail, Fig. 7. Care was used in running back the return mains to avoid all pockets and also to avoid dropping below the water line of the boiler, as this would prevent proper air relief.

In the first floor corridor two foot-warmers are installed, consisting of 12 sections each of 40 in. Vento heaters on 4-in. centers, hung in the duct, as shown in the cross section, Fig. 8.

Much of the space in the breathing walls on the first floor is utilized for flues necessary for a common fan supply system, these being omitted from the drawings to avoid confusion. By the use of these extra flues and some of the vents already installed it is possible, if ever desired in the future, to turn the system over into a "fan-supplied gravity exhaust" system without building any additional flues.

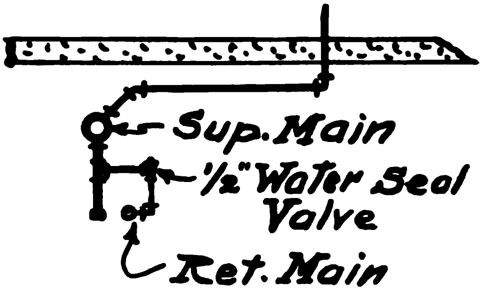

FIG. 7—DETAIL OF DRIPS ON MAIN.

The window deflectors are sections of glass sash about 12 in. high, these being carried between two wooden side wings by screws inserted through slotted holes in the wings. By this means the deflector can be lifted and set in any desired position, the details being as shown in Fig. 9, and the finished appearance as shown in Fig. 10.

The boilers are valved as shown in Fig. 2, owing to the necessity of maintaining higher pressure on the old building lines than is required on the modulation system, as previously explained. Double valves are installed on the return with a test tee between so as to allow the second boiler to be used either on the higher or lower pressure.

DEFECTS OF SYSTEM.

While everyone praised the ventilation, the coal bill was small, motor charges were nil, and the installation much cheaper than a fan system, yet, the question may be asked whether the system is as good as a fan-supplied ventilation system based on 30 cu. ft. per minute.

To this question the writer feels competent to answer, "No." This is in defiance of the almost unaminous verdict of the teachers and principal who are heartily

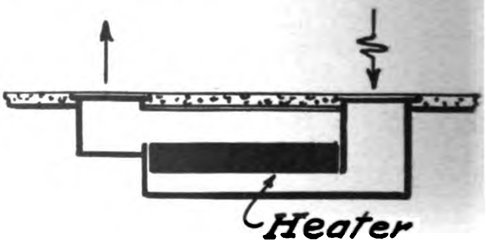

FIG. 8—FOOT-WARMER DETAIL.

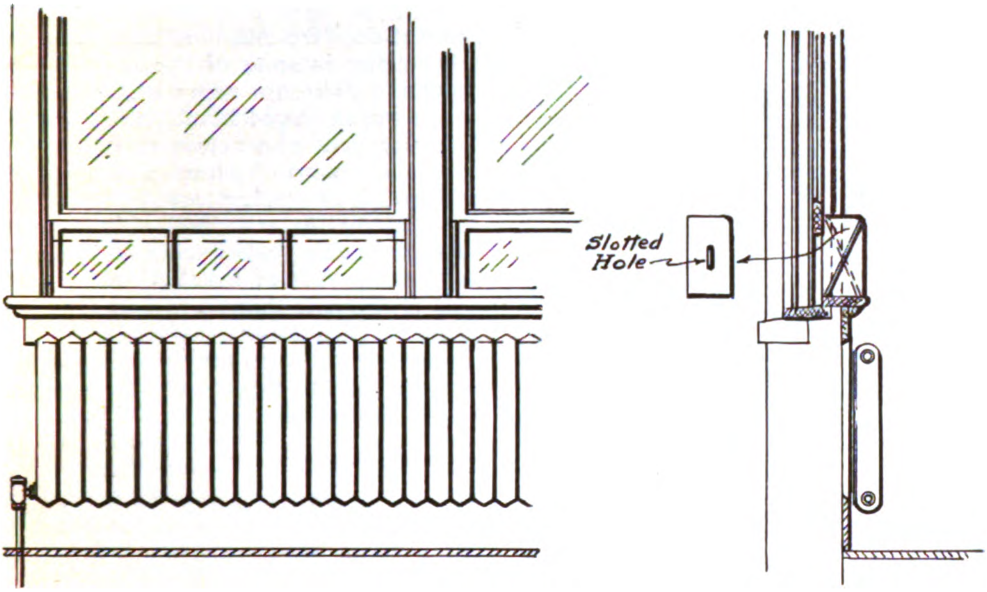

FIG. 9—DETAIL OF VENTILATOR, FEDERAL HILL SCHOOL.

in favor of the system. The objections are briefly these:

(a) Possible inadvertent omission on the teachers part to open the vent dampers full as soon as this can be done without creating drafts. (Many vent flues were almost entirely closed when inspected although there was no noticeable outside wind.)

(b) Similar possible omission in regard to the windows. (Many rooms were being used with only 50% of the windows open.)

(c) Absolute impossibility of controlling humidity.

(d) Absolute impossibility of washing or filtering the air.

(e) If less coal is being burned with this system than with a fan system of similar size, it stands to reason that *less* air is being delivered into the rooms.

(f) No positive air delivery at all times

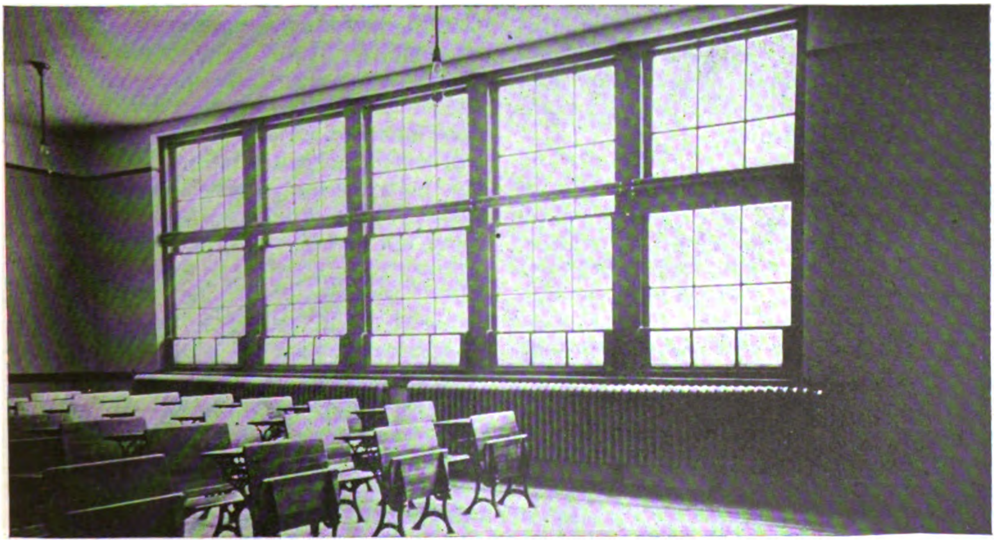

FIG. 10—FINISHED CLASS ROOM RADIATORS AND VENTILATORS, FEDERAL HILL SCHOOL.

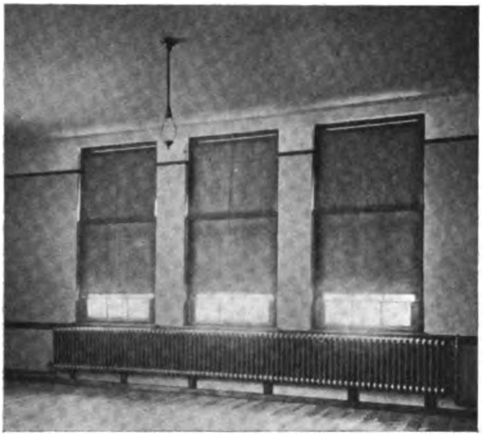

FIG. 12—AN 81-SECTION RADIATOR IN THE FEDERAL HILL SCHOOL.

nor any way to make delivery of any specified amount (either small or large) assured.

It can be seen from the above that in spite of the "freshness" of the air in the school, and in spite of the economy of operation there are many serious faults which can be urged against this method. Yet in sections where clean air is obtained from outdoors and where a fan system *without* an air washer would be the only other alternative on account of initial cost, this idea would undoubtedly be a saving on the first cost of installation.

It is specially desired to call attention to the large number of sections used in the radiators, these running as high as 81 sections on the single-column radiators and 76 sections on the two-column radiators; a view of an 81-section radiator is shown in Fig. 12. The building was designed by Walter P. Crabtree of New Britain, Conn., while the heating was designed by the R. D. Kimball Co. of New York and was installed by Libby and Blinn of Hartford, Conn.

Co-operating with the Consumer

With Suggestions for Changes in Steam Heating Equipments to Produce Economy in Operation.

BY WILLIAM J. BALDWIN, JR., C. E.

(Presented at the annual convention of the National District Heating Association, in New York, May 16-19, 1916.)

The consensus of opinion which seems to prevail, among present day progressive management of public utility properties, is agreed as to the wisdom of forming a friendly acquaintance and better understanding between the company and the consumer.

There is, however, a difference of opinion as to how far cooperating with the consumer should be extended. Many believe this is a very important matter, and one which should be considered from every angle. There can be *no* question, that a policy of independent indifference to the consumer's interest, so prevalent with many of the utility companies, *in former days,* is steadily giving way to one of cooperation, with a view of firmly establishing a mutually satisfactory business relationship.

The policy of willing cooperation is *far preferable* to forced regulations by commissions. The methods of applying such a policy will necessarily differ,—depending upon many conditions. No fixed, hard and fast rules or regulations can be set down to meet all cases. The working out of details in almost every individual case must be left, to a considerable extent, to those who come in personal contact with the consumer to diplomatically and carefully handle the matters as they come up.

POLICY OF GIVING SERVICE AS WELL AS SELLING STEAM.

A broad policy of *giving* service, as well as *selling* steam, was adopted and put into force, in a practical way within the last year by the present management of the New York Steam Company, with the result, that a *closer friendly understanding* exists between the company and its consumers.

While it is not the intention to criticise the policy of the former management of the company, you, who have lived in New York City and have been in touch with its building operations in former years, know the feeling of owner, architect and engineer towards not only the steam company, but every public utility corporation.

To the minds of *many*, it was a question of accepting a necessary evil. Possibly in some cases this feeling was not entirely justifiable, but was frequently due to a lack of *getting together* on matters of *mutual* interest. This feeling is fast passing away, due to the desire on the part of both the company and its consumers, to know each other better.

The *former* policy of the New York Steam Company—not unlike that of many other steam companies—was to avoid assuming any obligation in connection with the consumers' equipment and not to go beyond the service valves and meter. In carrying out this policy naturally, no adequate provision was made in its organization to take care of consumers' complaints, where the complaints referred to consumers' equipment. They were not prepared to render proper assistance to a new prospect or consumer who wanted advice on matters of steam, heating or power equipment.

CAUSE OF DISSATISFIED CUSTOMERS.

In consequence of their not being in position to advise or render assistance, either at the conception of the installation of an equipment, or thereafter when the consumer had equipment troubles, they were obliged to assume a side stepping policy of *apparent indifference*, by referring all such matters to the consumer's steam fitter, architect or engineer. The result of such a policy must be to have *dissatisfied* consumers. Although the consumers may have no legal claim, they *feel* the company has a moral obligation which it is trying to evade.

There may be a psychological reason for some of the ill feeling on the part of consumers towards a steam company. Is it not true, that when we do not understand a thing *clearly*, we are likely to be unreasonably critical and suspicious of it?

FEW PEOPLE UNDERSTAND STEAM.

Comparatively few people *really* understand steam, sufficiently to be able to clearly think in terms of steam. Many only vaguely associate the steam supply to the warmth of their premises, but seldom give the subject sufficient thought to reason out what actually takes place in the heating apparatus. If any part of the premises is not sufficiently warm, or if anything goes wrong, one thought only enters their mind; namely, the Steam Company is responsible. As a matter of fact, perhaps not once during the whole season has the steam supply been shut off or the steam pressure in the company's mains even been reduced below normal pressure.

Any one of a hundred or more things may go wrong with the heating equipment, but the consumer seldom takes any of these into account. Some consumers will never be satisfied unless every radiator is hot to the touch, and will not believe that the equipment is responsible for their discomfort. If a radiator is air bound or a room cold they believe it is the fault of the Steam Company.

Many cannot understand how steam is metered, and when you talk condensation, they think water is coming into their heating system from the street mains instead of steam.

To get them to differentiate between pounds of steam condensed and *used*, and pounds' *pressure* of steam, is often quite a task. If anyone is foolish enough to try and explain how the latent heat of steam is given off, the result is disastrous. It is better to talk in the plainest terms possible, and show by demonstration what actually takes place, and how results can be obtained, and how economies can be had.

About 95 per cent. of the residences we supply in New York have indirect radiation, which adds to the troubles experienced by consumers and makes more difficult the efforts to get them to understand their heating equipments.

You cannot *stop* consumers' complaints; they will continue so long as steam is supplied. It is a natural thing to expect and the consumer is not to be condemned, but should be reasoned with diplomatically, and here is where the success or failure of cooperation begins.

GETTING THE CONFIDENCE OF CUSTOMERS.

A small percentage of people *are* unreasonable, but the vast majority are willing to be met with a fair proposition, if it is presented in a spirit of friendliness. To simply say—*"You are wrong* and we are right"—*even* if the latter is the case, is poor policy from a business viewpoint. We must first get their confidence by expressing a willingness to help them;—then, by explaining carefully where and what their troubles are and how they can be corrected. We get their confidence in most cases, or at least partly overcome their former prejudice. This may not be done in one day, or even in one season, but a policy of untiring cooperation and willingness to work with the consumer will prove a profitable investment by making your customers boost for you instead of knock. It is good advertising, in building up a business or in maintaining one already started.

Few people want something for nothing, and those who do are more likely to try and get it without much complaining to the company. The consumer who makes a good honest complaint because he believes he is right can always be made a friend of if properly handled. To be able to give real cooperation, the company must be equipped with a sufficiently well informed force of willing investigators and a competent engineering department, capable of successfully coping with any condition which may come up. There is quite a distinct line between rendering consulting engineering services gratis and advising or helping a consumer. The former is an exceedingly poor policy, as it is assuming an obligation for which the company is not paid. It also places the company in the position of assuming a responsibility which is likely to lead to complications later. Once the company assumes the position of consulting engineer, it becomes perpetually so, and with no remuneration for such services, and with all the annoyance incidental thereto. The safer way is to simply advise the consumer what he should have and suggest where necessary that he procure the services of an engineer or steam fitter as the case may require, and then offer to cooperate and work with the engineer or fitter. There are times when the consumer requires assistance quickly. We might call it "first aid." A reducing valve has given out, or a house thermostat becomes inoperative, or the return trap floods, or something else becomes inoperative which should be taken care of at once for the comfort or safety of the occupant of the premises. Some member of the family or servant thinks only to call the Steam Company. This is the time when a little assistance may mean so much to the comfort of the consumer, and an ounce of help in time is worth a ton of regrets and explanations later. If you are not ready, willing and prepared to assist him and if you tell him to *"Get his steam fitter"* he is likely to remember it when some neighbor who contemplates taking the steam service, asks him how he likes it. The consumer as a rule does not expect you to install a new valve or trap, or to correct the defects in his equipment; he is willing to pay his steam fitter for this work, but he does expect assistance to help him get the best results from the use of your service with the equipment he has, and he expects the company to call to his attention things which are likely to cause trouble and make for high consumption.

While referring chiefly to heating consumers, the same policy will apply to power steam consumer.

We cannot stop at the front wall of the building and expect to have satisfied consumers. We must literally go inside and shake hands with the consumer and let him know we have his interests in mind as well as our own interests.

A real policy of cooperation should mean, that no matter what the complaint is, or when or where it is, the company is interested enough to investigate it without unreasonable delay, and advise the consumer as to what is best to be done.

The company's legal responsibility *should* stop at the front wall of the building, but the company's interest should not stop there, but should extend to a point where the consumer is getting the greatest possible efficiency and satisfaction with the use of the service.

PRINCIPAL COMPLAINTS OF CONSUMERS.

There are two chief complaints that consumers register against the Steam Company: "Our bills are too high," or "we cannot get enough heat."

You can see, therefore, cooperation along these lines is not compulsory, for the reason that both these complaints are matters entirely within the consumer's hands.. With a sufficient pressure of steam in the mains for heating or power, and with meters that are examined weekly and tested several times a season, we have complied legally with any demands that consumer can make or sustain.

The consumer who always complains at the amount of his bill does so through habit, not because he knows. Some consumers will never consider shutting off a radiator or a main stop valve, thinking the Steam Company might benefit by it. I have actually heard consumers say this, when explaining to them how to economize. If this class of consumer took as much time to get a heating engineer or steam contractor to go over his equipment with the assistance of the Steam Company engineer as he does to writing letters of complaint and threat, he would save time and money. It may not be good business to tell him this in so few words, but by offering to look over his equipment, and then by giving him a logical explanation of the reasons for his high consumption, you *may* get him to a point where he is willing to consider your suggestions, with the result that if he does save steam he is your friend and will take your advice thereafter without question, and will talk for you.

The consumer who is regularly complaining that he does not get enough heat, or is having trouble with noise or leaks, or inoperation of parts of his equipment, requires more constant attention than the average. This class of customer may be an actual loss instead of profit at first, due to the time and attention necessary to be given him; but these cases are comparatively few, compared with the whole, and, like a doctor who is obliged to give considerable time to the unprofitable patient, we must consider these as unavoidable. It will never do to let our patience become exhausted, for one dissatisfied consumer does more harm than a dozen satisfied ones *can repair.*

SOME TYPICAL FAULTY INSTALLATIONS.

It is not the intention to detain you with the small details of how we handle complaints in carrying out the policy of cooperation as set down by the present management of the New York Steam Company, but perhaps a little time to a few of the important details may not be amiss.

Until quite recently, few heating equipments were designed to take steam from the street mains in New York City. This resulted in many changes in piping and in the usual additions to the heating equipment, which were often made by the consumer's plumber or fitter, without the care or supervision of an engineer, or the cooperation of the Steam Company, and the results were often unsatisfactory.

Many of the older residences had old hot air furnaces, brick-set. These furnaces were removed, and the brick enclosure was filled up with indirect steam radiators, any old way to get in a few hundred square feet of heating surface, the amount the plumber or fitter thought was necessary to warm the house. Little attention was given to the question of the amount of air which should pass through the indirect radiators, or how much steam might be condensed, or as to whether the flues were large enough for such a system. The result is we have some remarkable examples of inadequate heating apparatus in some of our fine residences. Many of these systems have been and can be greatly improved and we are endeavoring to get the consumer's fitter to work with us, and by acting in an advisory capacity we often help the consumer, even though the equipment as installed can never be made ideal.

Again, let me say there is a distinction between acting as the consumer's consulting engineer and helping in an advisory capacity.

Sometimes it is advisable to suggest to a consumer to put in an entire new heating system, but this is not often.

SUGGESTIONS FOR PROMOTING ECONOMY.

There are certain things which can and should be done for ordinary good economy in almost every equipment, and if we will advise a consumer, and cooperate towards getting these things done, in the best possible way, the result will prove mutually satisfactory.

First: The matter of a proper means of controlling or regulating the supply of steam at a main stop valve. This can be best done in many cases by installing a house thermostat. This, if properly installed, will save its cost in a short time, and will always prove a good investment.

Second: The matter of recirculating at least part of the air in connection with the indirect radiators, instead of taking all cold air from out of doors, as is the general custom in New York.

In the average house, heated with indirect radiation, the amount of cold air admitted is far in excess of anything that is necessary for good ventilation. Often one-quarter of the amount of fresh air admitted would be sufficient for ventilation. If the cold air inlets are properly adjusted and the air in the house is recirculated through the indirect radiators a large quantity of steam can be saved. There are several ways this can be done at small expense.

Third: The matter of utilizing the heat in the water of condensation discharged from the heating system return traps before it goes to the sewer, should always be carefully considered. Most of the systems have a cooling coil through which the condensation is discharged, but frequently this simply cools the condensation and overheats the cellar. The cooling coil should be connected to the heating system in some way, and used as an economizer. About one-tenth of the total heat of the steam is available in the condensation and can be utilized and the steam consumption reduced proportionately.

When steam is used for heating water for domestic purposes, the heat in the condensation can be utilized for this purpose at a small expense by installing a preheater in connection with the hot water tank.

There are, as you know, innumerable small economies that can be suggested as secondary, such as temperature regulations for hot water tank, covering the steam pipes and return pipes, and other hot furnaces not used for heating; adjusting blowing air valves, improving steam traps, etc., and while these are secondary they are still important.

Then last, but not least, is the matter of instructing the consumer how to operate the equipment for daily economy, and to actually teach him or his servant how to do so, to get the best results. This requires much patience.

During the past winter we have had some remarkably satisfactory results from this policy of cooperation. Steam consumptions in many cases have been lowered from 10 to 30%, and in other cases, apparatus that were inadequate have been made to give fairly good satisfaction, and a small outlay on the part of the company and in many cases at small expense to the consumer.

We have tried to get the consumer's confidence, and in most cases have succeeded.

This policy of cooperation will necessarily lower the steam consumption and at first would seem to work against our sales department. It does not actually prove so, for the reason that the lower the steam consumption per month, the higher the rate that is charged per thousand pounds for steam. We all agree it is better to sell the same quantity of steam at the higher price per 1,000 lbs. This can be done by getting new consumers to take the steam thus saved. If you help the consumer he is more likely to tell his neighbor about it, and this paves the way to procure the new consumer.

What applies to the heating consumer can be made applicable to the steam power consumer. This past winter we have worked with many of our steam power consumers, and have at a small expense given them the help which they required. It has taken time, patience, and logical arguments in some cases, but the results are satisfactory. In one case we advised a consumer how to reduce their consumption about 40,000,000 lbs. per year. Acting upon this advice, they have spent approximately $30,000 for improvements and we have given them the time necessary to work out the details and have given them the benefit of our experience in the matter of these economies. The result of this cooperation has been mutually satisfactory, and we have closed a contract with them for an additional five years' service. In closing, let me say that the motto of the National Association of Master Steam and Hot Water Fitters, and one which I always considered a rather selfish one, is very apropos and applicable to cooperating with the consumer, namely:

"WHO HELPS ME, I HELP."

The Comparative Effects of Wind and Sunshine on Heating Buildings

BY DONALD B. PRENTICE.*

Rules for determining the heat loss from buildings invariably include a clause regarding the exposure, in effect as follows, "Ten (or fifteen or twenty) per cent. should be added to the heat loss calculated with the above constants, for a windy exposure." Nothing is ever said about decreasing the calculated heat loss because of sunny exposure, for the building must be heated on cloudy as well as sunny days, and the radiation installed must be designed for the maximum heat loss and the minimum heat gain from the sun's radiation.

Although the radiation allowed for warming a building can not be decreased because of a sunny exposure, yet the latter must have considerable effect on the annual coal consumption for heating. Has it more or less effect than a windy exposure? Is it better to build at a distance from other structures, which would be wind protectors, to secure a plentiful sunlight; or is it better to sacrifice the sunshine to gain wind shelter?

The test reported in this article offers some interesting information on the subject. Obviously it is difficult to compare heating records of different houses, for the construction can never be regarded as identical. But results observed in the same house from day to day, under varying weather conditions, are of considerable value, provided the house has wind and sun exposures sufficient to be materially affected by changes in these quantities.

The present test was made in an apartment covering the entire second floor of a frame-and-clapboard house. The building faces south and has a length of 60 ft. on this and the north sides. The depth is about 30 ft., and there is a 15 ft. space at the west end and 22 ft. at the east. The apartment is, therefore, especially well situated for this particular experiment. As the long sides are exposed to the sun and the north and northwest winds, with practically no protection (no buildings nearer than 200 ft.), and the rooms are entirely on the second floor, the effects of sun and wind are very noticeable.

The test was made with normal operation of the furnace. The living rooms were kept as near 70° F. as possible and the bedrooms about 60°. Enough coal was burned to maintain this temperature during the day, the fire being banked at night. The heating system was hot-air, the furnace having a 19-in. fire-pot and burning so-called yard-pea anthracite, about the size of No. 1 Buckwheat.

The weather data was secured from the local office of the U. S. Weather Bureau.

TEST OF ROYAL HOT-AIR FURNACE, SERVING SECOND FLOOR APARTMENT, 77 AVON STREET, NEW HAVEN, CONN.

December 6-12, 1915.

Date. 24 hrs. period.	Coal burned. (lbs.)	Mean outside temperature, deg. F.	Sunshine, per cent. of possible, hrs.	Average wind velocity. Miles per hr.
Dec. 6	98	30	26	14.2
Dec. 7	69	30	61	10.0
Dec. 8	115	31	0	5.2
Dec. 9	63	32	57	10.0
Dec. 10	98	24	100	20.0
Dec. 11	98	24	97	11.8
Dec. 12	92	25	94	5.6

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*Instructor in Mechanical Engineering, Sheffield Scientific School, Yale University.

The effects of wind on the heat loss from the apartment are shown by the results for Dec. 10, 11 and 12. An average wind velocity for 24 hours of 20 miles per hour, as on the 10th, is quite high. On the 11th the velocity was about one-half that of the 10th, and on the 12th about one-fourth. The sunshine for these three days was about the same, as was the outside temperature. And the daily coal consumption required to keep the apartment at the usual temperature was also practically the same, being a little less on the warmer day.

The first four days of the week give an interesting proof of the marked effect of sunshine. The wind and outside temperature were nearly the same, while the sunshine varied from nône at all to 61% of the possible number of hours. The necessary fuel consumption varied nearly inversely as the sunshine. The slightly less coal used on the 9th as compared with the 7th, despite fewer hours of sunshine, may be explained by the difference in outside temperature and the fact that on the 9th the period of sunshine was more nearly in the middle of the day, at the sun's greatest intensity. Comparing the results for the 6th with those for the 10th and 11th it is interesting to observe that the longer periods of sunshine on the latter days compensate for a difference of 6° in the average outdoor temperatures.

This test may be criticised for its shortness, and the writer realizes that many more observations should be made to verify or disprove the results. But the perfect consistency of these seven days is certainly interesting and inevitably leads to one conclusion. It may be relevant to state that the weather records were not secured from the Weather Bureau until the week following the coal measurement, so it was not possible to prove a preconceived notion.

From this week's record it is apparently true that wind velocity has very little effect on the heat loss from a reasonably well-built house, and that sunshine plays a very important part in decreasing coal consumption for residence heating. One would be justified, therefore, in exposing a house to fairly severe wind conditions, provided thereby an appreciable increase in direct sunshine was secured.

System of Individual Room Temperature Control.

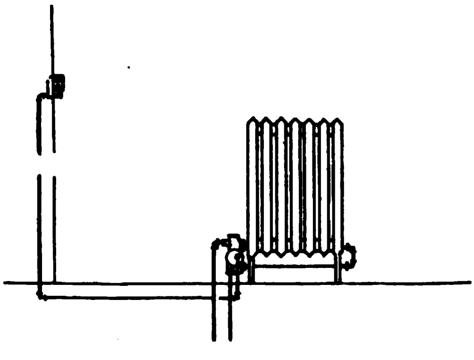
A system for controlling the temperature in a steam radiator and also automatically maintaining the required temperature in the room, has been designed by F. S. Richmond, consulting engineer, 840 Transportation Building, Chicago, Ill.

The main feature of the system is a packless thermostatic control valve on the inlet of the radiator which is operated by the temperature in the return line. The return pipe has no valve and is open direct to atmosphere or into the main vacuum return.

In normal position the supply valve is open and steam enters the radiator until the temperature in the return expands the thermostatic element and the valve is closed. The steam expands in the radiator and condenses until the temperature of the return falls below the predetermined point when the supply valve again opens and the cycle is repeated. As the thermostatic element is very sensitive (being a volatile liquid enclosed in flexible diaphragms), a change of a very few degrees is sufficient to operate the valve.

The valve when placed on the so-called atmospheric or graduated system is hand-controlled and operates as many people believe the ordinary system does; that is, by turning on the valve a little way you get a little heat and the more you open the valve handle the more heat you get. Steam radiation is used instead of water.

Each radiator temperature is controlled independently of the steam supply, whether below or above atmospheric pressure, and requires no balancing as to size of radiator or number turned on. On the atmospheric system, by placing a submerged check valve in the return beyond the valve, it is possible to expand the steam in the radiator down to 10-in. of vacuum even



ARRANGEMENT FOR INDIVIDUAL ROOM TEMPERATURE CONTROL.

though there may be steam pressure on the supply.

On the graduated system with air separator, the temperature of radiator will correspond to the vacuum carried in the system, or with check valves it may at times be lowered.

When operating on a vacuum system the valve is either hand or thermostatically controlled, or both, as desired. The steam is expanded in the radiator from supply pressure temperature down to vacuum temperature, thus preventing any re-evaporation in the return line. By changing the steam pressure from below atmospheric in mild weather to above atmospheric in severest weather with a corresponding high or low vacuum on the return, it is possible to secure the greatest economy in coal consumption.

In addition to the possible economical operation mentioned, a room thermostat is connected to the valve to maintain any desired temperature. The thermostat, 2½ in. x 3½ in., does not require any compressed air or piping, except a single pipe to the control valve, for its operation; it has only two moving parts, and its function is to close or open a simple valve. It has an adjustment for temperature which is not easily tampered with, and a hand shut off which, when opened, leaves the thermostat on its original temperature adjustment.

In operation, when the temperature of the room reaches the desired point, the thermostat closes the valve to the pipe leading to the radiator valve. This allows steam to pass from the main steam supply into the thermostatic chamber and the supply valve is closed by expansion of the thermostatic element. Thus the control valve is kept closed as long as the temperature of the room is high enough to operate the thermostat.

The valve may be used on vacuum or air line systems, or on a two-pipe gravity system by placing an air separator and return tank at the boiler.

Radiating Surface Required to Heat Water in Tanks.

Recently one of New York's prominent architectural and engineering firms, Messrs. Timmis and Chapman, was called upon to figure out the amount of radiation required in a sprinkler tank to keep the water from freezing. The following calculations were made by Walter S. Timmis, of this firm:

A = area in square feet of exposed surface of tank.

K = constant for tank material per degree difference. Note: for 3 in. wood use 0.3; for steel tank use 2.0.

D = difference of temperature of water and outside air.

B = thermal units heat loss per hour from water to air.

L = pounds of steam condensed per hour per square. feet of pipe.

T = latent heat of steam (assumed for low pressure at 966).

$B = A \times K \times D.$

Then the total heat units condensed = L T.

And square feet of heating surface =

$$\frac{A\ K\ D}{L\ T}$$

Values of L are as follows:

(From Kent's Pocket Book.)

	Value of L=steam condensed per hour, per square feet of pipe, pounds.		
(*)	Iron	Brass	Copper
50	7.5	12.5	14.5
100	18.5	38	43.5
150	32.2	76.5	87.8
200	48	128	144

*Mean temperature difference between water and steam (sensible heat) deg. F.

Special Standard Threads for Fixtures and Fittings.

The American Society of Mechanical Engineers has published a report of its committee on standardization of special threads for fixtures and fittings on straight pipe threads. The committee was appointed in 1914 and has worked in conference with several manufacturers of electrical and gas fittings. The report consists of 12 printed pages and develops standards for what are described as special straight fixture pipe threads and special straight electric fixture threads. Edward S. Sanderson was chairman of the committee.

Fuel Burning Reports.

Under the title of "Fuel Burning Reports," the American Engineering Co., Philadelphia, Pa., is issuing a series of pamphlets illustrating the performance of the Taylor stoker in plants of varying size and with widely varying operating conditions. It is stated that these results have been obtained by the users of the stoker on the lowest grade of fuels as well as on the highest grade of fuels. No. 1 of the reports has just been issued and contains the records of 30 tests. Size 6 x 9 in. (standard). Pp. 62.

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THE possibilities for co-operation in engineering and trade matters are well illustrated in the following instance. We received a letter from a prominent engineer in a Southern city asking us if we would send him a model for an anti-smoke ordinance for his city. "We have just gone through a $6,000,000 fire," he wrote, "and the building laws are being changed. Numbers of buildings were in this fire district which should have smokeless boilers and if I had the proper data to put before our city fathers, I think I could get this through at this time. Just now the cry is, 'Rebuild right,' and I think for office buildings, etc., which burn soft coal, the smokeless boiler should be installed. Kindly tell me what you think of this and the success of same in other cities which have such laws."

By referring this matter to a man well qualified to offer suggestions on this subject we were able to forward to our correspondent the information that Bulletin No. 49 of the Bureau of Mines, Department of the Interior, contains a very complete digest of the smoke ordinances of the country, and we were also able to send him a suggested smoke ordinance drawn up by Osborne Monnett, of Chicago, based on four years' experience in administering the Chicago smoke ordinance.

The ordinance as drawn up is especially adapted for a small city and so well covers the ground that we have struck off a few extra copies which are available, on request, to those interested in securing such a code for their city.

We should be glad at this time to present the sequel to this story and state that our correspondent had been successful in securing the passage of the desired ordinance. That is another story, however, as the matter is still in its initial stages. But there is certainly something to be said in favor of the initiative shown by our correspondent and the splendid co-operation displayed by the man having the desired information.

◆

WE are planning to make the July issue of THE HEATING AND VENTILATING MAGAZINE an air conditioning number. For this occasion articles have been prepared tracing the development of air conditioning during the past decade, the present state of the art and some notes on the future of this field. There will also be several articles illustrating present practice in different branches where air conditioning is accomplished in connection with heating and ventilation, the whole, it is hoped, forming a fairly complete manual on the subject.

◆

THE publication of the weather charts in the present issue concludes the 1915-1916 series. The charts will be discontinued, as usual, during the summer months and their publication resumed in the fall.

NATIONAL DISTRICT HEATING ASSOCIATION

Proceedings of Eighth Annual Convention, New York, May 16-19, 1916

Complete confidence in the future of the central station heating industry; closer co-operation on the part of the utility company, the public service commission and the consumer; and, finally, the coming invasion of the East with the district heating idea, were three keynotes that were expressed in no uncertain tones at the eighth annual convention of the National District Heating Association. The meeting was held in New York, May 16-19, 1916, at the Hotel Martinique. It may have been due to its sessions in the metropolis which brought about the allusion to the "Eastern invasion," but the idea was expressed by Arthur Williams, commercial manager for the New York Edison Company, when he declared that eventually New York City would be heated throughout from central heating stations.

BYRON T. GIFFORD, GRAND RAPIDS, MICH.
President, National District Heating Association.

The assured future of the industry was also expressed by Mr. Williams and was brought forcibly home to the delegates by Secretary D. L. Gaskill in an impromptu address that was described as one of the "hits" of the convention.

The notable address of Travis H. Whitney, one of the public service commissioners from New York City district, emphasized the great need of a better understanding on the part of the utilities and the commissions, when, he declared, it would be found that they were both working for the best interests of each.

The convention met under unfavorable weather conditions, the first two days of the convention being cold and rainy.

Morning Session, May 16.

President Davis S. Boyden called the convention to order and introduced Marcus M. Marks, president of the Borough of Manhattan, who made the welcome address.

Mr. Marks said the danger to the American business man is in making his business an end of life rather than a means of life. Moreover, business men are not taking active measures to show their power in government. We see lawyers in legislatures, everywhere, but the business men as a class are devoted to their offices, their factories and their shops.

Mr. Marks said self-sacrifice was the needed slogan in public life. The business men of the country need to be aroused and then, but not till then, shall we have good government. The business men of the country, as well as the lawyers, should be our mayors and our members of congress.

The government, he said, does not represent the sentiment of the business community today because the business men are not more active in political affairs. "I urge you," he said, "to take office whenever the opportunity offers. Get into public life."

First Vice-President Byron T. Gifford responded to the address of welcome and endorsed the recommendation of the borough president that business men generally, and especially members of the National District Heating Association, should make a serious effort as managers of public utilities, to take a more active part in public life.

Mr. Gifford also called attention to the fact that the New York Steam Company's plant was one of the sights of the city to association members, being easily the largest district heating system in the country, with 4,200,000 sq. ft. of direct radiation connected and furnishing no less than 2,500,000,000 lbs. of steam per year.

The report of the executive committee was read by Secretary D. L. Gaskill, who presented the names of a number of candidates for active and associate membership. On special recommendation Professor John R. Allen, of the University of Michigan, was elected to honorary membership. On motion the candidates for active and associate membership were elected.

PRESIDENT'S ADDRESS.

President Davis S. Boyden then presented his address:

As president of your association, it is my privilege to address you at this, your eighth annual convention, being held in the largest city of our country. It must be a source of gratification to the founders and charter members of this association who have witnessed the rapid growth, success and accomplishments attained by the association in the comparatively short period of its existence.

The farsightedness of these gentlemen is evidenced in the report of the organization meeting held at Hotel Boody, Toledo, O., on July 15, 1909, when, after considerable discussion, it was decided the association should be national in its character, rather than confined to a local or geographic section.

At this meeting were also pointed out the great possibilities of improving the district heating industry, including the many accessories and appliances so essential to its economic and profitable development.

It was predicted that the activities of the association would be an asset to the electrical industry, in the securing of large contracts for electrical energy.

These important points were touched upon at this first meeting, the minutes of which are recorded in less than two pages of our proceedings. To my mind, this is a terse outline of our most vital functions. That the several past administrations have carried out these ideas in an able manner is clearly shown by a perusal of our transactions, which have become a text-book on district heating enlarged upon and brought up to date annually. Great credit reflects upon those who, at the sacrifice of time and money have contributed to these valuable works. The transactions are the back-bone of the society's power, and the reference of authority for all interested in the manufacture, distribution and consumption of heat. The field of study has not been confined to that of heating alone, but includes all uses of steam, such as the requirements of prime mover process work and cooking. Along all lines there has been extensive research. Data on construction and operation have been collected, compiled and recorded in such form that it may be used on a comparative basis by any member. It is hardly necessary to elaborate on the magnificent work which has been accomplished.

In the early days of the association, the securing of new members was not an easy task. However, the membership at large co-operating with their officers, was the solution of the problem, and a widespread campaign resulted in securing a sufficient number of members to insure the permanency of the organization from the very beginning.

I am also able to congratulate you upon that which I believe to be more important that numbers—and that is—the fact that this association is rapidly becoming the center of all matters pertaining to the arts which depend upon the application of heat, and that our proceedings are watched with growing interest, not only by the whole steam public of this country, but also abroad.

We may say that the National District Heating Association has come into its own—and no longer does our association seek to profit from its members, but, on the contrary, members seek and receive profit from the association.

We have, at the present time, 364 members, and the field of prospects has hardly been approached. The National Electric Light Association, undoubtedly the greatest of industrial associations to-day, closed the sixth year of its existence with 259 members, or 105 members less than we have at the present time.

Turning to the industry, we do not find the universal confidence and appreciation in district heating as exhibited in other public service commodities. This is not at all singular when you stop to consider conditions. Obviously, a district heating plant to operate successfully must have, first, a field which is highly developed. A field of this character usually affords the comforts of modern heating which is rendered to the occupants with more or less satisfaction. So, it could hardly be expected that the general public would have a full appreciation of district heating service. The producer and consumer of heat are the ones most vitally interested in district heating, and never fail to show their appreciation of the service after once being connected to such a system.

This silent servant, which contributes intermittently to our comforts, dates from antiquity, and it is not surprising that in this age it does not receive the prominence of our modern utilities. Not unlike the early days of the gas and electric development, there were failures in the industry In these instances the cause has been clearly shown, and the industry profited by the experience.

THE PLANT OF THE BOSTON HEATING CO.

Undoubtedly the most gigantic district heating failure occurred in Boston, in the year 1887. The Boston Heating Company, as it was called, proposed to circulate water under pressure having a temperature of approximately 450° F., this water entering a receiver on the customer's premises flashed into steam, the pressure being controlled by a diaphragm which regulated the in-flow of hot water to the receiver. The distribution system comprised upwards of 10,000 ft. of mains, enclosed in a brick tunnel 18 in. in diameter, the supply pipe being 4 in. and the return pipe 12 in. in diameter, mammoth pumps being used to keep the water in circulation through the pipe lines and heater. It was contemplated that 1,000 buildings aggregating 130,000,000 cu. ft. of space, would be supplied with heat, power and hot water service. To avoid the irregular contour of the surface, a fixed grade for the pipe line was established, necessitating the tunnel to be constructed in some places to a depth of 27 ft. below ground. The insulation applied to the pipes was an untreated asbestos paper, similar to that used at the time for inside work. Great difficulty was experienced in keeping the system tight, and the plant ceased to do business after eight months' operation.

Probably there have been other more or less unprofitable ventures made, and these instances have proven valuable object lessons.

The most discouraging effect resulting from these failures has been the pessimistic impression imposed upon the laymen, to whom we look for financial support.

Subsequent to the period cited above, constant progress has been made in both systems and structures employed for the distribution of heat, and the many successful plants now in operation are rapidly dispelling the pessimist.

It would be ungrateful, indeed, if we did not make creditable mention of the manufacturers, who have contributed much to our present success by the supply of proper systems, fitting accessories, and measuring devices. In this respect, we may assume to be better provided for than are other utilities, as there are large establishments specializing in products used exclusively by the district heating industry.

That the approval and confidence of the public in district heating is fast being restored, is forcibly brought to our attention by the constantly increasing number of new companies, together with the rapid growth of those already established.

To create a universal demand for distrist heating, we must educate the public in its possibilities, such as the conservation of our natural resources, elimination of smoke, increased health and comfort to our people, etc.—and last—the security of our investments. The present publications of the society, with the assistance of the trade journals and the daily press, are doing excellent work in this direction

SUGGESTION FOR LECTURE BUREAU.

I wish, however, to recommend for your consideration the establishment of an extensive committee or bureau, whose duties it would be to impart information by lecture or literature to communities, municipal agents, boards of trade, financial interests, boards of directors, and other similar civic bodies, bearing on the modern district heating system. The members on this committee to be selected with reference to their geographic location and qualified by their successful experience in steam or hot water heating.

I believe we should join the National movement in the prevention of accidents, and appoint a committee to study the accidents and their prevention as peculiar to our industry.

I suggest that a committee on constitutional amendments be appointed to study and recommend any changes in the constitution or by-laws, which may more adequately cover the association's present interests; this report to receive the endorsement of the executive committee before acted upon by the association.

I recommend that the special committee appointed to prepare a geographic and individual classification index of the membership be continued and the roster in this form mailed to each member.

During the year there has been inaugurated the National District Heating Association Bulletin, the official organ of the society. Three issues of this bulletin (which is published quarterly) have been mailed to each member. The publication committee has outlined the policy and assumed a general supervision over the editorial and advertising columns. The editorial committee has furnished generously both reading and advertising material, and, under the direction of and assisted by their chairman, attended to the business details in their respective localities.

The benefits created and accruing as a result of the Bulletin are far-reaching and of inestimable value. It is an unabridged encyclopedia of our art, embracing the business and social activities of the society. That the Bulletin has become a fixture in our organization is extremely gratifying to the administration.

Secretary-Treasurer D. L. Gaskill reported receipts for the year of $5,869 and expenses of $5,558, leaving a balance on the year's operations of $311.

The association has a membership of 354, consisting of 182 Class A members, 71 Class B members, 23 Class C members and 78 Associate members.

Secretary Gaskill gave a detailed report covering the publication of the association's quarterly Bulletin, showing a slight profit on the three issues already published and prospects of increased profits on future issues. The Bulletin, he said, had more than justified its existence and has fully proved its value to the members. Starting with a small advertising patronage, the Bulletin will carry in its next issue at least fifteen pages of advertising, insuring its financial success during the ensuing year.

It was stated that a topical index of all of the Proceedings of the Association had been compiled up to and including 1915. It is planned to reproduce this index in Volume 8 of the Proceedings, which will shortly be issued.

A list of the association's members by companies and occupations has also been compiled by R. D. De Wolf and was distributed at the convention.

President Boyden appointed as the nominating committee S. Morgan Bushnell, chairman; R. D. De Wolf, A. C. Rogers, George W. Wright and J. H. Walker.

REPORT OF PUBLIC POLICY COMMITTEE.

The first of the technical reports was then presented by the public policy committee, D. L. Gaskill, chairman. This report was devoted to the matters of committee work of the association, costs and accounting, franchises, welfare work, medical examination, rates, and purchasing supplies. The point was made that there is danger in committee work of covering too wide a ground. Fewer lines of force were recommended and more intensity along those followed.

On the subject of franchises the committee found that it was not practicable to prepare a model franchise for the use of heating companies, owing to the fact that no one form would be adapted to all States. It was found to be better to speak of some of the things which should or should not be in the franchise.

In preparing franchises there is usually no trouble but what there will be enough in them. Municipal bodies and their solicitors and the companies and their lawyers will not usually err in this direction. The trouble usually is in what they have put in, not in what they leave out.

The committee makes the following suggestions this year. Do not accept a franchise covering the entire municipality in which you are located. Specify definitely the parts of streets and portion of the municipality that you desire to serve, leaving future extensions to be covered in future grants. The reason for this is obvious. Where the franchise covers the whole municipality, governing bodies are ready to require unprofitable extension to satisfy popular clamor, without thought of the losses that may be incurred. While relief may generally be had from such orders through the commissions, it is better to be in a position to refuse to accept the franchise offered than fight to get rid of its provisions before some court or tribunal. Where franchises must be accepted covering the whole of a municipality, provision should be contained therein that would fully protect the interests of the company in making unprofitable extensions. No extension should be required under a franchise unless the immediate income from such extension would be sufficient to pay for the extension in the time as below stated. Without such condition, sooner or later unprofitable extensions will be demanded.

Whether or not to accept a franchise or order for an extension is oftentimes a difficult problem, as the territory to be served is often close to the border line between profit and loss. The committee was of the opinion that such extensions should bring in such immediate gross income as would pay for the extensions in five years, or a yearly percentage basis about 20 per cent. It was recommended that this suggestion be investigated and reported upon by some one of the standing committees.

Franchises should have some definite date for termination unless granted under some indeterminate law of the State in which the company is located. Many franchises have been created with no language therein specifying when they were to end or saying that they were to be perpetual. Many of the holders of these grants believed them to be perpetual franchises, but courts have been holding that when there was no language in them designating or indicating that they were to be perpetual or for a term of years, the grant was revokable at any time at the will of either the municipality or the company. Heating franchises should be long. The high cost of installation does not warrant accepting short term franchises, and we recommend that no franchise be accepted less than twenty-five years and they should be longer.

Franchises should provide for adequate space to be occupied in the installation of steam pipe lines, insulating covering, etc., and should also provide for quick and easy accessibility to the heating mains without the necessity of special permits from governing bodies. In some cases where steam is to be transmitted by high pressure it is advisable to have pipes in small concrete or brick raceways which will permit inspection of the pipe at all times, and there should always be provided enough space so that the proper size of pipe could be used for economical operation.

Franchises should not be accepted where they require compensation to be paid for the use of the streets of the municipality as the cost of municipal compensation added to the cost of construction and operation may seriously interfere with the success of the undertaking, there being in many instances a comparatively narrow margin of safety from the financial standpoint. The advantages to the community in having district heating plant service, doing away with the inconvenience and trouble connected with independent furnaces and doing away with the smoke evil, will in a large measure compensate the municipality for the occasional inconvenience caused by opening streets for repairs or pipe line construction.

In speaking of rates the committee stated that the time is ripe, on account of the high cost of all materials entering into the heating business, to permit and justify an advance in rates wherever franchises and commissions will permit it.

President Boyden appointed as a resolutions committee Thomas Donohue, chairman; Fred. B. Orr, C. H. Spiehler, C. R. Bishop and C. N. Green.

REPORT OF EDUCATIONAL COMMITTEE.

A report of the Educational Committee was then presented by George W. Martin, chairman. This report dealt largely with the use of low pressure steam in cooking apparatus. The tests covered in the report were: "The Establishment of Standard Heating Apparatus with Special Reference to Low Pressure Steam," by J. W. Wattles of the Edison Electric Illuminating Co. of Boston; "Tests on a Copper-Jacketed Kettle Under Various Conditions of Pressure," by J. H. Walker, of the Detroit Edison Co.; "A Study of the Heating Effects of Various Steam Pressures Applied to the Printers' Wax Pot," by Herbert Kennedy of the New York Service Co., and "Test of the Steam Consumption and Electrical Requirements of a Hotel Laundry," by E. F. Tweedy of the New York Edison Co., the latter test being of the installation in the Hotel Martinique.

The committee expressed the opinion that the steam consumption for restaurants be reduced to an amount per meal or per person, and the steam consumption for laundries reduced to an amount per thousand pieces or similar unit. Other steam-using operations can doubtless be reduced to a similar basis.

In discussing the report the use of steam for cooking purposes was pointed out as one of opportunity for the central station heating engineers. The problem, it was shown, was centered largely in the adapting of steam at low pressure for this purpose. One speaker stated that such an installation may now be seen at the Travers Island clubhouse of the New York Athletic Club, where all of the cooking is now being done with low pressure steam. Mr. De Remer spoke of a similar practice in San Francisco, where pressures of 3 lbs. or lower were found sufficient for cooking purposes. He stated that it was necessary to educate the manufacturers and users of this type of apparatus through the influence of competition to take up the use of low pressure steam.

Afternoon Session, May 16.

At the opening of the afternoon session the report of the Underground Construction Committee was presented by J. H. Walker, of Detroit. This report included descriptions of several methods of making heat loss tests from underground pipe conduits, such as heat loss from bare pipe in soil, an insulation test conducted by the Public Service Company of Northern Illinois, the careful methods used by the American District Steam Company, as well as the well-known methods employed by the Armstrong Cook Company. Other features of the report were suggestions for testing steam conduits, contributed by W. M. Sawdon, a description of the testing plant of the Detroit Edison Company, a general description of the testing equipment at Purdue University and also of the steam pipe covering plant at the University of Wisconsin.

In connection with the latter tests it was pointed out that the scientific method of conducting a research is to first ascertain what variables are likely to affect the results and then, keeping all constant but one, to vary that one between wide limits to observe its effect. Each of the others in its turn is treated in the same way.

An interesting discussion of the report was contributed by W. H. Wells, president of the American District Steam Company.

HEAT INSULATION TESTS.

For the last three or four years I have devoted considerable time to testing the efficiency of various forms of insulation.

One fundamental truth which has forced itself upon me from the first has been that with no insulation at all other than a vacuum you have the best, provided it is confined; next to that the lighter gases, such as highly rarified superheated steam, form the best insulating mediums; and after that, the atmosphere itself.

Condensation losses may be classified as convection losses, those due to conductivity, and those due to radiation.

Convection losses are relatively small underground, because there is practically no circulation of air.

Losses from radiation underground do not exist in the same proportion as they are encountered in the air.

Losses from conductivity underground are considerable, but we have not made any experiments as to these losses as tests made underground are much more difficult to make than laboratory tests or those which we have conducted of various forms of insulation in a closed room. In a closed room, with the test lines raised several feet above the floor, conductivity losses are reduced to a minimum and the convection losses practically do not amount to much. In tests made in closed rooms the only condition under which you find convection losses serious is where you test a steam pipe without any insulation. This test is scarcely a fair one, because the heat from the pipe creates currents of air which by bringing constantly supplies of cool air in contact with the pipe materially increases the condensation in the pipe.

The best insulation ordinarily available is the atmosphere itself; but the insulating effect of the air is not in proportion to the amount.

Two-inches of air insulation will give you no better results under ordinary conditions than 1-in. If you have an air space of 1¼, 1½ or 1¾-in. the insulating efficiency is little if any better than with an air space of 1-in.

This air space is a better insulator than anything else you can get; but care must be taken to prevent the air from circulating, and at intervals along the line which is being insulated partitions should be provided to prevent any circulation of the air.

Higher insulating efficiency is obtained from the air space than from any insulating material. Various materials may show high efficiency taken independently; but you will obtain a much higher degree of efficiency if you maintain 1-in. of air space and supplement this with other insulating material to confine the air. If you should fill the air space with any insulating material you would lose insulating efficiency, because the conductivity loss from the material used to fill the air space is greater than it is through the air itself.

It is customary to speak of line losses as amounting to a certain weight of steam per hour per square foot of surface. This statement is generally misleading because the amount of condensation or line losses in different sizes of pipe varies considerably. If you have in your system of underground mains steam pipes of 4, 6, 8, 10 and 12-in. sizes the line losses in the larger sizes of pipe per square foot of surface is much less than in the small sizes of pipe; and it is most incorrect to refer to line losses as amounting to so much per square foot of surface per hour without at the same time stating the diameter of the pipe.

It is this difference between the condensation loss in large sizes of pipe and small sizes of pipe under similar conditions which makes it impossible to place absolute reliance on the results which are obtained in laboratory tests, as such tests are made with small sizes of pipe and the line losses are generally calculated from the condensation obtained in that pipe, and proper consideration is not given to the fact that in practice the line losses would relatively be much less in the larger sizes of pipe which are used in extensive underground systems.

One cannot make any positive statements with regard to what the line losses will be in any system unless the sizes of pipe and the pressures under which they are operated are known.

Another point to be taken into consideration in determining the amount of line losses should be the temperature of the steam conveyed in the pipes. It is common to speak of the steam as being carried at given pressures, and efforts are made to determine the relative line loss due to differences in pressure. This relative difference does not vary in proportion to the difference in pressure, but in proportion to the difference in the temperature of the steam, and the heat losses in the pipe are always relative to the difference between the temperature of the steam and the temperature of the surrounding medium.

To figure these losses steam at 100 lbs. pressure should not be compared with steam at 10 lbs. pressure, but steam at the temperature due to 100 lbs. should be contrasted with steam at the temperature due to 10 lbs. pressure. The difference between the temperature of the steam and the surrounding medium determines the condensation losses, and this difference is governed not by the difference in the pressure of the steam, but by the difference in the temperature of the steam.

The report of the Nominating Committee placed the following in nomination, all of whom were elected at a subsequent meeting:

NEW OFFICERS.

President, Byron T. Gifford, Grand Rapids, Mich.

First vice-president, George W. Martin, New York.

Second vice-president, J. H. Hecht.

Third vice-president, J. C. Hobbs, Pittsburgh, Pa.

Secretary-treasurer, D. L. Gaskill, Greenville, O.

Members of executive committee: C. A. Gillham, of New York, and A. E. Bettis, Kansas City, Mo.

The first technical paper of the meeting was presented by S. Morgan Bushnell, on "Factors in the Growth of District Heating."

This paper reviewed some of the more prominent factors in the development of the central station heating industry, starting from the early days of the art forty years ago. Reference was made to the organization of the American Radiator Company in 1899, whose tangible assets have increased from $8,584,000 in 1899 to more than $26,000,000 at the present time.

He also quoted from data gathered by the American District Steam Company showing that over $60,000,000 has already been invested in central steam heating plants. This, it was explained, referred exclusively to underground construction.

Mr. Bushnell also discussed the development of smoke prevention and quoted from a recent government report in proof of the statement that the central station heating plant is one of the most important factors in reducing smoke and soot.

A lively discussion followed the reading of this paper, the speakers including Past Presidents Wright, Wetherell and De Wolf, and C. L. Hecht and C. R. Bishop. Mr. Hecht urged the development of the use of gas as a heating medium, his idea being that this was one of the things that would have to be seriously considered in the near future. All of the speakers took an optimistic view of the outlook for central station heating, although the opinion was expressed that the greatest opportunities lay in the heating of business, rather than residence, districts. Regarding the use of gas for heating, Mr. De Remer called attention to a fundamental factor in connection with gas heating. In New York, for instance, with gas at 80c. per 1000 cu. ft., the total B.T.U. amounts to 600,000 B.T.U., while 1000 lbs. of steam costs 60 cents and contains 1,000,000 B.T.U.

Other speakers referred to the importance of securing adequate rates, which, it was shown, were still too low in many localities.

Morning Session, May 17.

After passing on a number of routine matters, including the formal election of officers, as put forward by the nominating committee, the convention took up a further discussion of the report of the educational committee.

The report of the station operating committee was then presented by Byron T. Gifford, chairman. Three general subjects were considered in the report, consisting of sections on boiler operation, illustrating a method of efficiently carrying a load on a boiler by means of indications afforded by a set of switchboard instruments; water treatment, its cost and results obtained from it, also the effect of caustic soda on iron and steel; and extraction or bleeder type turbines, discussing the value of extracting steam, the reduction in production cost due to this type of turbine under certain conditions. The report also contained a general discussion of oil as fuel, showing results to be obtained and the possibility of future development with oil as fuel.

Pending the discussion of this report the convention listened to an address by Arthur Williams, general commercial manager of the New York Edison Company, on "District Heating and Its Relation to Electric Utility Operation." Mr. Williams proved himself an ardent champion of the central station heating idea and predicted a brilliant future for this industry, stating, among other things, that he expected to see central station heating in New York developed to such an extent as to be practically universal.

Following Mr. Williams's address the station operating committee's report was discussed by Joseph Harrington, A. E. Duram, S. Morgan Bushnell and L. E. Shaw, who told of recent developments in bleeder turbine design.

Morning Session, May 18.

At the opening of the Thursday morning session a paper was presented by William J. Baldwin, Jr., chief engineer of the New York Steam Company, on "Co-operating with Consumers." This proved a most interesting account of the problems and other difficulties that arise in dealing with the average user of steam from a central plant, especially in the case of residences. Mr. Baldwin's paper is reproduced in full on another page of this issue.

Mr. Donnelly spoke of a case where the supply and return connections to the steam radiators in the building were of the same size and, the connections being made when the system was not in use, it was found later that the air valves were at the wrong end of the radiators. This, he said, was an instance of the need of co-operation to show the consumer that the fault is often not in the service itself.

Mr. Baldwin, in closing the discussion, mentioned a practice that had been adopted by the New York Steam Company in making estimates of the theoretical steam requirements of its different customers and checking these with the actual consumption. Then if the consumption figures were found to be running high the company's inspectors immediately began an investigation to learn the cause and, if possible, to correct it.

President-elect Byron T. Gifford was then called to the chair and took advantage of the occasion to express his appreciation of the honor conferred upon him. He pledged his efforts towards the advancement of the association's interests, especially in the way of wider committee activities which he considered of the first importance.

The discussion of the station operating committee's report, which had been cut short at a previous session, was continued by Mr. Harrington, who explained in detail the new form of side wall construction for boiler settings, in which use is made of a course of silocel to reduce the heat losses through the side walls. Another speaker showed that the transmission through a 25-in. wall of No. 1 firebrick was at the rate of 872 B.T.U. per square foot per hour, while with the silocel construction, with the wall 19½-in. thick, the rate of heat loss was only 338 B.T.U., showing a saving of 61%.

The morning session was concluded with an address on "Appraisals of Utility Property," by M. F. Millikan, vice-president of the American Gas and Electric Co. This was a thoughtful discourse on the matters of utility valuations for the purpose of rate making and taxation. At the conclusion of the address a vote of thanks was tendered Mr. Millikan by the Association.

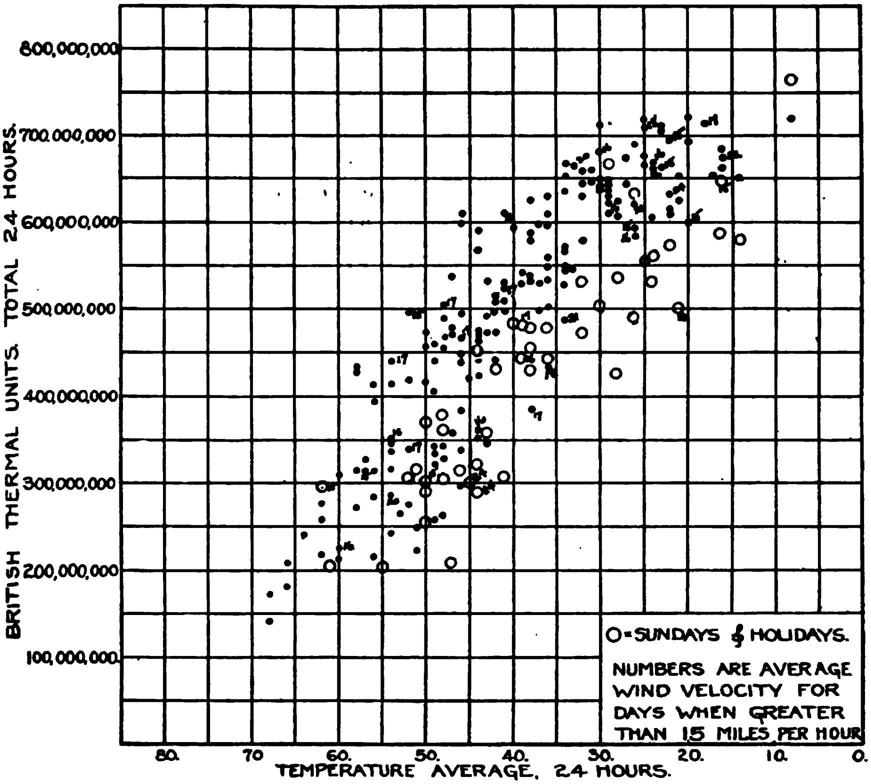
Thursday Afternoon, May 18.

A comprehensive report of the rate committee was presented at the opening of the Thursday afternoon session by A. E. Bettis, chairman. This report contained data relative to heating rates similar to the data that were collected by the association committee of 1912. These data were compiled in such a way that comparisons can be readily made between the former and present data collected, showing changes that have been made by the various heating companies throughout the country.

It was shown that the general tendency is to increase heating rates. This refers both to flat and meter rates. Ten steam companies which filed reports have abandoned flat rates entirely. Two steam companies raised the flat rates they had, while five companies raised their meter rates. In regard to hot water companies, there were five companies that increased their rates. The report was supplemented with a statement on the theory of rates.

Mr. Gifford urged the members to avoid the use of the term "discriminating rates" in speaking of varying charges for steam heat, as these rates are not discriminatory, but are strictly on a par with wholesale and retail prices in other lines of business.

Mr. Partridge cautioned the members to have their cases fully prepared when appearing before public service commissions to have their rates raised or maintained, and he pledged the support of the association to any member who required financial assistance in preparing his case. The sentiment expressed by Mr. Partridge was greeted with applause by the convention.



RELATION BETWEEN TOTAL B. T. U. SUPPLIED TO A BUILDING AND OUTSIDE WEATHER CONDITIONS.

The first paper scheduled for the afternoon session was then presented by Walter J. Kline on "Ratio of Economizing Coils of the Different Types of Heating Systems."

The author explained that economy coils are another name for cooling coils because the water of condensation must be cooled in order that the available heat can be utilized. But as this process is merely incidental, it is important to use the more descriptive appellation.

As used in central station heating practice economy coils are a necessary auxiliary to adapt existing piping in buildings to an outside steam supply. It is briefly an indirect radiator, arranged so that all condensate from the individual heating system must pass through it.

The author went on to describe the different kinds of heating systems making use of economy coils and gave data for figuring the sizes of the coils and notes on methods of connecting them. The paper closed with figures on the savings effected through the use of economizing coils, these savings running from 7 to 16 cents per square foot of coil surface with steam at 50 cents per 1000 pounds.

Mr. Wetherell stated that in his practice he found that the use of additional radiation served the same purpose as the cooling coil, one of the disadvantages of a cooling coil, especially in large installations, being that it had to be broken up into several sections serving as many registers, in order to avoid the overheating of the air.

Mr. Kline expressed his agreement with Mr. Wetherell in the latter's statement that the use of an Atmospheric system served the purpose of the cooling coil and in a better manner, but that in the case of systems already installed the cooling coil was more easily available, as compared with an Atmospheric system.

E. G. Bailey then presented a paper on "Methods by which Harvard University Buys Steam on a Heat Unit Basis." The first portion of the paper was given over to a description, with illustrations, of the extensive steam heating system by which heat is supplied to some 25 buildings containing a total volume of 14,704,557 cu. ft., the steam being carried in tunnels from the power station of the Boston Elevated Railway Co. Payment for steam is based upon a capital charge which is dependent upon the demand, plus a service charge of so much per boiler horsepower.

The meters selected for metering the steam were the Bailey fluid meter of the orifice type (described in THE HEATING AND VENTILATING MAGAZINE for May, 1916). Return meters were used, also of the Bailey weir type, utilizing a V-notch. The average pressure and temperature of the steam determined the B.T.U. per pound, which, multiplied by the total flow, gave the total B.T.U. delivered.

The accompanying figure is a plot of the B. T. U. supplied to the building of Harvard University and the outside temperature, taking individual days during the heating season 1915-16. Sundays and holidays are shown as circled points. The numbers near some of the points correspond to the average wind velocity for the days when it exceeded 15 miles per hour.

The B. T. U. as given are the gross supplied, and about 12 per cent should be deducted for the net. The slope of the average line corresponds to about 9,000,000 B. T. U. net per day per degree change in temperature, or about 1.6 B. T. U. per day per cubic feet of building heated. This corresponds to about 20,000 cubic feet per horse power for a 70 degree difference between outside and inside temperature. Several of the buildings in the College Yard do not have their entire volume thoroughly heated. All of the newer buildings are provided with weather strips, but double windows are not used.

The Freshman Halls comprise about 23 per cent of the total volume of all buildings heated, while they take about 33 per cent of the total heat. This difference in ratio of heat to volume is accounted for by the fact that the Freshman Halls are heated all of the time and a considerable amount of steam is used for service water and cooking.

Morning Session, May 19.

Travis H. Whitney, Public Service Commissioner of New York City, was the principal speaker at the Friday morning session, making a carefully-prepared address on the relation between public service commissions and utility corporations. Mr. Travis urged a greater confidence on the part of the utility companies in the work and rulings of the public service commissions, and emphasized the point that the commissions were attempting to serve the utilities as well as the public.

The report of the meter committee was presented by F. B. Orr, chairman. This report took up the changes and developments of the past two years. Several types were described, including the Tyler and Cranetilt types, the Bailey fluid meter and the velocity type steam meter brought out by the Foxboro Company under the name of Foxboro. Several developments of some of the older meters were also described and this was followed by suggestions for the metering departments of central station companies, containing notes on the selection of meters, number of meters required, and inspecting and testing.

The report concluded with a recommendation that manufacturers be asked to furnish examples of their meters which can be tested by a future meter committee.

Before the convention adjourned a number of resolutions were passed expressing the thanks of the convention to the retiring officers and to the various committees.

The Entertainment.

A pouring rain on the opening day of the convention interfered with the proposed automobile tour to Long View, but the committee was equal to the emergency and provided closed cars which took the ladies around the downtown streets of New York and across the Brooklyn Bridge. The ladies came back with glowing accounts of their ride which proved all the more interesting in having no definite route.

The next day, Wednesday, was the day of the boat ride around Manhattan Island. The party left on the Nassau from the foot of East 34th street, immediately after the close of the morning session. A buffet luncheon was served on board. Proceeding up the East River, the Nassau steamed past Blackwell's Island and then swung into the Harlem river, passing through no fewer than twelve draw bridges before reaching Spuyten Duyvil. The opening of the draws, however, was a source of great interest, holding the attention of the travellers equally with the other sights of the river. Passing into the Hudson River the party was taken down past the interned German steamers and thence into the Upper Bay, permitting a close view of the Statue of Liberty and Ellis Island.

Passing around Governor's Island, the Nassau came back up the East River, under the Brooklyn and Williamsburg bridges. A detour was then made toward the Brooklyn Navy Yard where several of the battleships could be seen at close quarters.

Thursday morning, the third day of the convention, the ladies were taken to the Metropolitan Museum of Art, and in the afternoon to the Hippodrome. For the Hippodrome trip each lady was presented with a box of bon-bons with the compliments of the New York Steam Company.

The convention banquet was held the same evening. An unusual feature of this banquet was the presence at the head table of all of the past presidents of the association, the retiring president and the president-elect. A. S. Armagnac, chairman of the banquet and dance committee, acted as toastmaster.

At the close of the dinner, during which the cabaret girls from the Silhouette Room of the Hotel Martinique, entertained the diners, Secretary D. L. Gaskill was introduced and made a short address in connection with the presentation of gold medals to all of the past presidents. Immediately upon the accomplishment of this duty the retiring president, Davis S. Boyden, sprung a surprise by presenting a similar gold medal to the secretary. The diners enjoyed the situation immensely, and expressed their pleasure by heartily applauding Secretary Gaskill. He frankly confessed that the executive committee "had put one over" on him and expressed his thanks for the honor conferred on him.

H. A. Austin, the "poet laureate" of the association delivered a poetical "skit" on past presidents in general, which brought down the house.

The speaker of the evening, Reginald Pelham Bolton, was then introduced, his address being on "Revolutionary Relics on Manhattan Island" Mr. Bolton spoke with the aid of lantern slides. He proved full of his subject and held the close attention of the diners while he told of the many interesting finds in the upper part of the island, many of them being shown on the screen. The appreciation of the diners was expressed by a standing vote of thanks for his intensely interesting address.

The diners then proceeded to the Garden where dancing was in order until a late hour.

Friday morning, with improved weather conditions, the trip to Long View, originally planned for Tuesday, was carried out under sunny skies and proved a great success.

With the Exhibitors.

The convention exhibits overflowed the hall assigned to them and a number were located on each side of the main corridor. The booths were formed of white wood, with a trellis effect, making a most attractive appearance. A considerable number of the devices exhibited were practically new to the trade and represented the notable advance that has been made during the past year in the development of the practical side of the industry.

H. W. Johns-Manville Co., New York. had a display which included samples of J-M sectional conduit for the underground insulation of steam and hot water pipes; also J-M pipe and boiler insulation, J-M steam packing, the J-M steam trap and

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J-M fibre conduit. The company was represented by F. J. Medway and J. H. Olden.

RicwiL Co., Cleveland, O., showed a model of the RicwiL underground pipe conduit, consisting of a cross section of two types of installation, single and multiple. C. Gottwald, secretary and treasurer of the company, was present, as well as F. H. Stevens, engineer, and C. M. Stokes, eastern representative.

Armstrong Cork & Insulation Co., Pittsburgh, Pa., exhibited a model illustrating the application of Nonpareil high pressure covering to underground steam lines and the roller supports for the same purpose. Another model showed the application of Nonpareil insulating brick to the drums and setting of a water-tube boiler. The interests of the company were in the hands of C. A. Senter, of the New York office.

Jenkins Bros., New York, had an attractive booth where the company's hospitality was dispensed by William G. Le Compte and Frank Martin, of the home office. The company's exhibit included a full line of radiator valves, including a fractional supply valve and an impulse return check. Samples of the company's line of gate valves, standard, medium and heavy, were also shown. A regular valve fitted with a sprocket sheath wheel and hand chain attracted much attention. An electrically-illuminated flash sign called special attention to the display.

General Electric Co., Schenectady, N. Y., showed several types of the G.E. steam and water flow meters. These included a G.E. indicating, recording and integrating meter, two G.E. indicating meters and various nozzle plugs, pipe reducers, etc. A stereomotograph was used to show lantern slides of some fifty characteristic installations. The company was represented by R. E. Woolley, of Schenectady.

National Air Cell Covering Co., Brooklyn, N. Y., was one of the prominent exhibitors of insulating materials. Samples of the Pyro-Bestos underground covering were on display, showing the pipe guides and broken joint construction. The company was represented, as in previous conventions, by G. Clarence Hall, of the home office.

American Steam Gauge & Valve Mfg. Co., Boston, Mass., exhibited the American recording gauge, the improved Howard blow-off valve and the American Ideal steam trap. The company's booth was in the main corridor and was the rendezvous of an interested throng. Representatives of the company present were C. A. Allen, manager of the New York branch; P. H. Ryan, William Wagner; also J. E. Swendeman, of the Boston office.

Illinois Engineering Co., Chicago, Ill., had a display of its graduated supply valves, thermo return valves, vapor, atmospheric and vacuum heating specialties; as well as pressure reducing valves and back pressure valves. J. C. Matchett, of Chicago, was in charge of the exhibit, and Louis Helmer, the company's eastern manager, was also on hand.

E. B. Badger & Sons Co., Boston, Mass., exhibited different types of the Badger corrugated copper expansion joints, with patented equalizing rings. The fact that 1,000 expansion joints of this type of fitting are now being installed in the new underground steam conduits of the New York Steam Company added special interest to the exhibit.

Chapman Valve Mfg. Co., Indian Orchard, Mass., had an impressive display of its extra heavy iron body, bronze mounted gate valves, with double-seated self-packing tops for underground steam service, as used by the New York Steam Company; also standard inside screw and extra heavy outside screw and yoke bronze gate valves. The company's representatives in charge were R. C. Mitchell and Charles F. Webber.

Tyler Underground Heating Systems, Pittsburgh, Pa., showed its new condensation meters; also its underground ditch construction, single and multiple; tunnel construction, ditch and tunnel pipe casing. expansion joints and anchors. E. B. Tyler was in charge of the company's interests.

American District Steam Co., North Tonawanda, N. Y., had its usual full display of the company's method of underground construction, including models of all the various special devices which constitute its standard equipment. There was also a working model of the Simplex condensation meter, showing the manner in which steam service is sold to buildings for heating purposes. Another interesting feature was an illuminated screen demonstrating the operation of a radiator in connection with the Atmospheric system of steam heating, with the steam supply to the radiator controlled by an Adsco graduated radiator valve. The company's representatives in attendance were W. H. Wells, president; C. R. Bishop, secretary; Robert Hall, treasurer; H. C. Kimbrough, J. A. Bendure, W. J. Kline and R. C. Holley.

Plant Engineering & Equipment Co., New York, showed samples of the Lind strom Corliss valve steam trap of the constant flow type and also the Penco thermo gauge, a new device used to prevent trap leakage. The temperature of the thermo gauge tells at once where or not the trap valve is tight. The company's headquarters are at 6 Church St., New York.

Tillotson Humidifier Co., Providence, R. I., had a display of Tillotson steam traps and Tillotson humidifiers. The booth was in charge of Ira D. Lambert, of the company's home office, at 78 Fountain Ave., Providence.

Central Station Steam Co., Detroit, Mich., showed its packless diaphragm type expansion joint and its continuous flow condensation meter in operation. The company's representatives were Prof. C. B. Veal and W. R. Owen.

Farnsworth Mfg. Co., Boston, Mass., successor to F. C. Farnsworth, of New York, had on exhibition types of its separating traps, pumping traps, vacuum traps, condensation traps and Farnsworth duplex boiler feeders. F. C. Farnsworth and J. F. Nelson, of the New York office, had charge of the company's interests.

Gilmore Mason, 615 West 162d St., New York, had a new device on view in the shape of the Mason meter, designed to measure condensation. The meter is of the dump bucket type but is remarkable for its simplicity, being the result of Mr. Mason's extensive experience as meter inspector for the New York Steam Company. Plans are going forward to market the meter on a large scale.

Michigan Pipe Co., Bay City, Mich., showed life-sized models of its tin-lined underground wood pipe covering, with shells of various sizes.

Consolidated Engineering Co., Chicago, Ill., as usual, had an elaborate display, similar to its exhibit at the convention in Chicago last year. An electrically-operated fractical valve was connected to a glass radiator, and a colored shade showed the method of controlling the steam supply to the radiator. Another device shown in operation was an electric-driven boiler feed pump. This was in addition to the line of Van Auken vacuum heating and Thermograde modulation heating specialties. F. K. Davis, of the New York office, had charge of the exhibit.

Republic Flow Meters Co., Chicago, Ill., showed a working model of the Republic flow meter, designed to measure the amount of fluid passing through a pipe to which the instrument is attached. The measurement is accomplished by means of a small electric current which is regulated by the flow of the fluid and recorded on electrical instruments mounted on a panel at any distance from the pipe. In this case the connection was made to the steam service in the laundry of the Hotel Martinique and the readings were shown on the meter in the company's booth. James D. Cunningham, president of the company, was in charge.

Bailey Meter Co., Boston, Mass., displayed types of the new Bailey fluid meter which records and integrates the flow of steam, water and air at any pressure, temperature and capacity. The use of this meter in the Harvard University buildings, which was described in a paper read at the convention, lent special interest to this exhibit. E. G. Bailey, inventor of the meter and president of the company, was kept busy explaining the new device to those interested.

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Central Station Heating Notes.

Rainer Heat & Power Co., Seattle, Wash., operated during 1915 with a net income of $5,416, its gross income being $7,213, and taxes paid out totaling $1,797, according to its annual report filed with the public service commission. The company's gross revenue was $32,106, and its operating expenses, $24,892.

Davenport, Ia.—The People's Light Co. has asked for a renewal of its heat franchise which expires in 1921. The extension was asked at this time so that the company can go about making extensive improvements in its system.

Indianapolis, Ind.—How the city may eventually become smokeless is indicated by the changes that have been effected at the flour mill plant of the Acme-Evans Company. Formerly the mill was operated by the company's own power plant, but with the introduction of electrically-driven machinery and steam supply by the Merchants Heat & Light Company, the power plant at the mill has been shut down and the smoke stacks wrecked.

Rock Rapids, Ia.—At a recent city election $15,000 was voted for a municipal heating plant, to be operated in connection with the lighting system.

Pottsville, Pa.—It is announced that the Eastern Pennsylvania Light, Heat & Power Co. will spend between $250,000 and $500,000 this summer in improvements to its lines.

New Ulm, Minn.—Property owners on Minnesota Street, between Center and

Second Street, will have their buildings heated from a central station, if the plans of the Commercial Club of that city are carried out. The club appointed a special committee, composed of H. N. Somsen, Alf. J. Vogel and Ferd. Crone to look into the matter. A practically unanimous sentiment was found on the part of the property owners in favor of the plan. General consent was also given to the plan to secure easements to run the steam distributing pipes through the front of the basements of the buildings, this arrangement being found less expensive than to run them in the alley in the rear of business houses. The initial cost of the plant, according to an estimate of the Chas. L. Pillsburg Engineering Co., of Minneapolis, will be $20,000.

Sibley, Ia.—As a result of a meeting held recently at the Commercial Club, the project for a municipal heating plant for Sibley has received new impetus. It was the sense of the meeting that the plan as proposed, to use the exhaust steam from the lighting plant, was quite feasible and that a corporation be formed to take up the proposition, inasmuch as the town itself was not in a position to act at this time. It was understood that when the plant had paid for itself and had given the investors a certain amount of interest on their capital, it was to revert to the city. Three committees were appointed, one to consult with the Council regarding a franchise, another to solicit users of heat to co-operate in the undertaking and the third to look after the financing of the project. The entire cost is figured at $16,000, and it is planned to have the corporation handle one-half in cash, with a mortgage to cover the balance. This is rated at practically $10 a foot, the idea being to have about 1,500 ft., running from the light plant north to Ninth Street, then west to the business houses.

Helena, Mont.—A franchise for the installation of a central heating plant in Helena has been granted to the Gerharz-Jacqueth Engineering Company, a favorable vote having been taken on the project at a special election. The franchise requires that the heating company invest at least $25,000 within two years. At first it will serve only the business district, but it is expected later that the system will be extended to cover the residential section as well. Work, it announced, will be started at once.

Spokane, Wash.—A 25-year steam heating and electric light franchise has been granted by the City Council of Spokane to Fred. B. Grinnell. Rate regulation by the city is provided, also control of meters and character of the service. Construction work must begin within one year; ten blocks must be laid within two years, and $100,000 invested within three years. For the first five years, Spokane will receive a franchise tax of $2,000 per annum, and thereafter $2,500 per annum, but at no time shall the franchise tax be less than 1% of the company's gross earnings.

Martin & De Remer, New York, who recently opened engineering offices at 100 Broadway, specializing as engineers and managers of public utilities, industrial plants and district heating systems, announce that George J. Henry, hydraulic and mechanical engineer, of San Francisco, Cal., with offices in the Rialto Building, is associated with them.

Underground Specialties Co., New York, which, as announced last month, has been formed by Charles H. Staten, will make a specialty of steam and electric conduit protection and insulation, as well as central heating and lighting plant equipment. Mr. Staten, who is at the head of the new company, has been connected with this branch for the past 18 years. He has also made a study of sewage disposal and water purification and is prepared to design and install systems of this nature. The company's offices are at 1476 Broadway.

H. R. Wetherell, of Peoria, Ill., who has been appointed steam expert for Hopendyl, Hardy & Co., New York, will not make his headquarters in New York, as announced, but, for the present, will be located in Peoria.

Arthur D. Little, Inc., Boston, Mass., announces that a Dominion charter has been granted in Canada to Arthur D. Little, Ltd., a corporation organized and equipped for the service of Canadian industry and the study and development of Canadian resources. The new company has opened offices in Montreal, Canada, at 137 Gill Street. The special facilities of the new corporation will be supplemented by the entire staff organization and equipment of the Boston firm.

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"Sheet Metal" Purchased by E. A. Scott.

Edwin A. Scott, formerly secretary of the American Society of Heating and Ventilating Engineers, has purchased Sheet Metal, published monthly in New York. The June issue is the first to appear under Mr. Scott's direction. The publication is devoted to the furnace and sheet metal industries. Mr. Scott will have the good wishes of his many friends in the trade in his new work.

LEGAL DECISIONS

Tax on Central Steam Heating Companies.

Under the Pennsylvania act of May 23, 1889, as amended by the act of May 16, 1901, giving to cities of the third class the right "to levy and collect a license tax not exceeding $100 each annually on all contractors * * * steam heating, gas, water, light and power companies," it is held that a city of the third class has the right for general revenue purposes to enact by ordinance that "all gas companies or individuals furnishing light or heat thereby shall pay annually a license tax of $100."—Altoona City vs. O'Leary, 60 Pennsylvania Superior Court, 159.

Defective Steam Heating Plant—Waiver by Tenant.

A tenant rented a house at a summer resort for one year from July 1, by a lease which provided that he was to take the premises as he found them and was not to call on the lessor for any repairs, and that $100 was to be deducted from the last payment of rent, to be applied to alterations, repairs, etc. He took possession and paid the first quarterly installment of rent September 1, after having made an inspection of the heating plant. On September 25 he wrote inquiring about an option for a year's extension of the lease. After occupying the house four months, he resisted payment of the second installment of rent, due November 1, on the ground of misrepresentations of the lessor as to the condition of the heating plant. The New York Appellate Division, Stokes vs. Avila, holds that he could not escape payment on such a ground, any such misrepresentations being waived by his conduct and delay. His inspection of the premises in August had revealed the non-existence of floor radiators and the absence of connecting pipes and an estimate obtained for the necessary repairs, after which he paid the first term's rent.

Where Heating Plant Is Not a Trade Fixture.

The city of New York condemned premises occupied as a hotel and saloon and contracted with a wrecker to remove the buildings. A steam heating plant which had been placed in the premises by the tenant's father, who had formerly conducted the business, was sold by the tenant, along with the other contents of the building. The wrecker brought an action for the conversion of the heating plant. The New York Appellate Division, Levenson Wrecking Co. vs. Hillebrand, 157 N. Y. Supp., 515, holds that the heating plant in a building used as a hotel saloon is not a trade fixture, and the action would lie, as the plaintiff had an existing right to the immediate actual possession of the plant at the time of the conversion.

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The Warm-Air Furnace Publicity Campaign.

A publicity campaign that will cost, it is understood, close to $25,000, has been inaugurated by the National Warm Air Heating and Ventilating Association in an effort to increase the popularity of warm-air furnace heating. The appeal is being made to the general public through such mediums as The Saturday Evening Post.

Inquirers are urged to send for the association's "Book on Heating and Ventilation," and all replies received at the association headquarters in Columbus, O., are transmitted to the members.

The accompanying trade-mark, which has been adopted by the association, is used extensively in its advertising. As will be seen, this sort of publicity not only calls attention to the campaign of the furnace manufacturers, but is also one of the most important propagandas that have been started to awaken the public on the general subject of good ventilation.

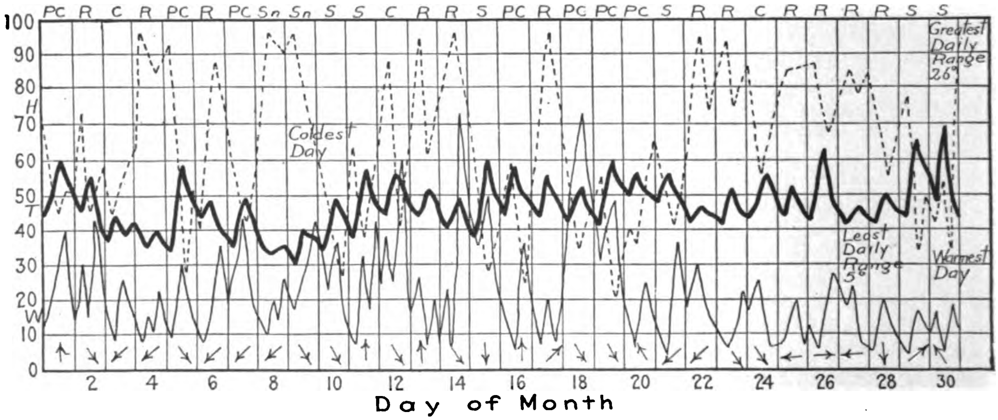
NATIONAL WARM AIR HEATING & VENTILATING ASSOCIATION
FRESH
AIR
HEAT
MEANS
HEALTH

EMBLEM OF THE NATIONAL WARM AIR HEATING AND VENTILATING ASSOCIATION.

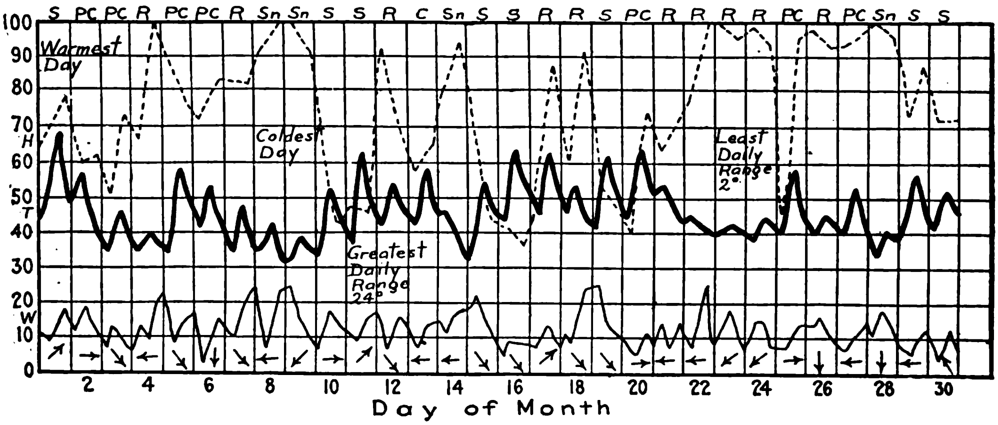
A notable feature of the advertising is that the association offers free engineering in connection with the design of any installation, the advertisments reading "if you would have a heating plan drawn to fit your home, write us and we will see that it is supplied you without cost."

The Weather for April, 1916.

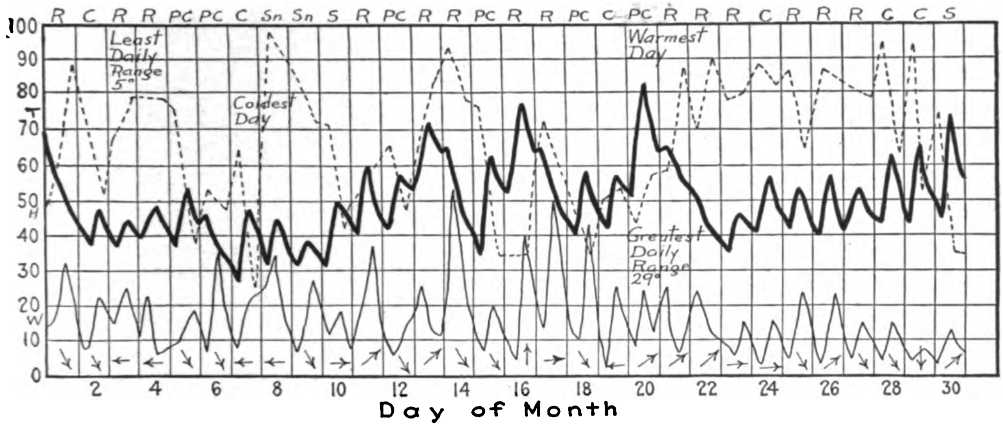
	New York.	Boston.	Pittsburgh.	Chicago.	St. Louis.
Highest temperature, degrees F...........	69	68	82	77	85
Date of highest temperature..............	30	1	20	12	12
Lowest temperature, degrees F............	30	32	28	26	30
Date of lowest temperature...............	9	8	7	6	6
Greatest daily range, degrees F..........	26	24	29	34	32
Date of greatest daily range.............	30	11	20	12	11
Least daily range, degrees F.............	5	2	5	3	6
Date of least daily range................	27	23	3	26	2
Normal temperature for month, degrees F.	47.1	46	49	48.1	54.4
Normal mean temp. for month, degrees F.	48.1	45.3	51	45.9	56.1
Total rainfall, inches...................	3.28	4.51	2.54	1.6	1.78
Total snowfall, inches...................	3.3	4.2	5.7	None	Trace
Normal precipitation, this month, inches...	3.3	3.55	2.9	2.88	3.52
Total wind movement, miles...............	12,471	8,221	8,466	9,854	10,508
Average hourly wind velocity, miles.......	17.3	10	11.8	13.7	14.6
Prevailing direction of wind..............	N.W.	N.W.	N.W.	W.	N.W.
Number of clear days.....................	6	9	2	8	8
Number of partly cloudy days.............	9	7	6	8	9
Number of cloudy days....................	15	14	22	14	13
Number of days on which rain fell........	17	14	16	13	13
Number of days on which snow fell.......	2	4	2	None	1
Snow on ground at end of month, inches..	....	...	...	...	...



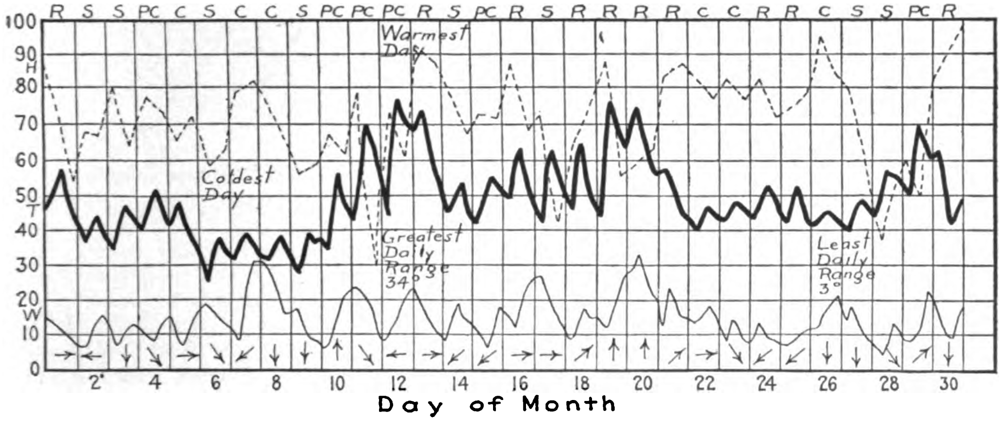
RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1916.
(Hourly Observations of the Relative Humidity are Plotted on This Chart.)



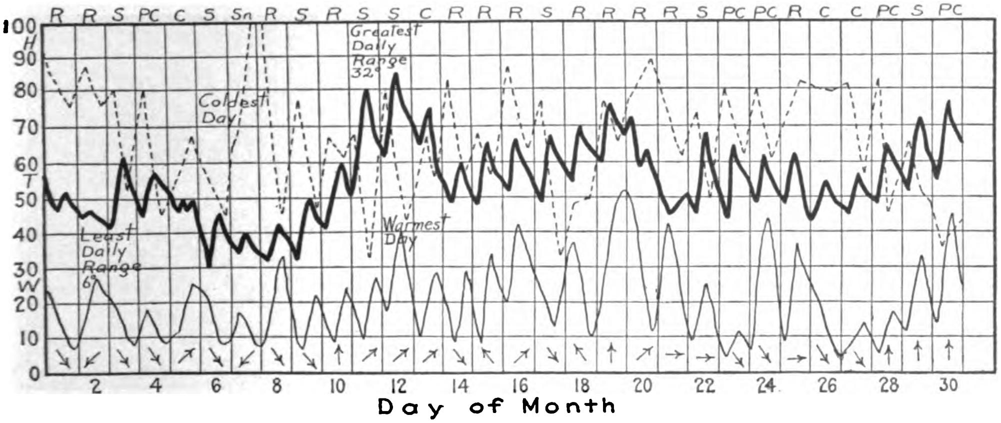
RECORD OF WEATHER IN BOSTON FOR APRIL, 1916.



RECORD OF WEATHER IN PITTSBURGH FOR APRIL, 1916.



RECORD OF WEATHER IN CHICAGO FOR APRIL, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Plans for Summer Meeting.

On his return from a trip to Detroit and Chicago on society matters, Secretary C. W. Obert announced that the headquarters for the society's mid-summer meeting, to be held in Detroit, Mich., July 19-21, will be at the Hotel Statler. The sessions on the opening day, Wednesday, will be held at the hotel. The next day, Thursday, the delegates will be taken by the Michigan Chapter to Ann Arbor, with a professional session at the University of Michigan, and an inspection of the testing laboratory of Prof. John R. Allen. Prof. Allen is conducting some new and interesting tests which he will describe to the delegates. The Friday session will be held in Detroit.

Annual Dinner of New York Chapter.

The successful get-together meetings of the New York Chapter, which have been a feature of the past season, were brought to a fitting close May 22, when the chapter held its annual dinner at the clubrooms of the Building Trades Employers' Association, on West 33d Street. Following the practice at other recent chapter meetings, a special committee had been appointed to take charge of the meeting, and it was stated that the success of this arrangement will no doubt lead to its adoption another year, the new president, Arthur Ritter being credited as the originator of the plan. By dividing the membership into a given number of groups it will give the opportunity to every member of the chapter to serve at some time during the year on a meeting committee.

At the conclusion of the dinner, which was supplemented with cabaret features, President W. H. Driscoll announced that the chairman of the May meeting committee, A. S. Armagnac, would act as toastmaster. Mr. Armagnac said that the development of a more friendly spirit in the chapter was the principal feature of the past year's activities and that the plan on which the chapter was being operated would no doubt tend to increase good-fellowship among the members. There is much talk about co-operation, he said, in engineering matters, as well as efforts to improve engineering ethics and professional fees, but these projects will not get very far until the members get to have a genuine interest in each other's welfare and get to know each other better.

He then introduced Prof. Charles E. Lucke, of Columbia University, who delivered a thoughtful address on the "High-Speed Internal Combustion Engines, With Special Reference to Aeroplane, Automobile and Speed Boat Requirements." Prof. Lucke talked with the aid of blackboard illustrations and held the attention of the diners for over an hour with a discussion that was commented upon as a masterful presentation of the subject. He brought the matter home to the members by stating that the time is coming when high-speed units, located at the application of the power, will supplant the present practice of generating the power at a central point and distributing it in different directions. He characterized the internal combustion engine as a complete power plant in itself and urged every engineer to watch more closely the developments in this field. Prof. Lucke was heartily applauded at the conclusion of his address and the diners gave him a rising vote of thanks.

Closing Meeting of Illinois Chapter.

C. W. Obert, secretary of the American Society of Heating and Ventilating Engineers, was a guest at the May meeting of the Illinois Chapter at the Hotel Morrison, which brought the season's program to a close. During the usual chapter dinner, a cabaret performance was given under the direction of Ray Stackhouse. In the absence of President E. L. Hogan, Vice-President W. F. Powers acted as toastmaster. Secretary Obert, who was the first speaker, told of some of the plans for the coming summer meeting of the society, July 19-21, in Detroit.

President Harry M. Hart, of the heating engineers' society, also spoke, urging that those present, not already members of the chapter, apply for membership.

Annual Meeting of Massachusetts Chapter.

The annual meeting of the Massachusetts Chapter in Boston, May 9, took the form of a noonday luncheon. The committee reports, as well as the treasurer's report, showed a successful year of effort, with a substantial balance in the treasury. New officers were elected as follows: President, Fred S. Boltz; vice-president, W. W. Underhill; secretary, Charles Morrison; treasurer, William T. Smallman; board of governors: William G. Snow, Frank Irving Cooper and Eugene R. Stone.

The chapter meetings will be resumed, after the summer months, the first Tuesday in October.

Michigan Chapter Hears Address on Car Heating.

Elmer W. Reitz, chief engineer of the Chicago Heating Company, was the principal speaker at the May meeting of the Michigan Chapter, which was held in Detroit, May 9. Mr. Reitz's subject was "Heating Cars in the Future," and he told of the methods that are being developed whereby the temperature in Pullman berths may be regulated by a turn of the wrist.

Prof. John R. Allen, president of the chapter, recently met with the loss of an eye through an accident in which his eyeball was pierced by a small stick on which he had stepped. In his absence the meeting was presided over by E. E. McNair.

Secretary C. O. Obert of the society was the chapter's guest and William F. Verner, of the University of Michigan, also spoke. It was stated that the present membership of the Michigan Chapter is 55 and that plans were going rapidly forward in connection with the society's forthcoming meeting in Detroit.

Eastern Pennsylvania Chapter.

A dinner meeting of the Eastern Pennsylvania Chapter was held May 11 at the Engineers' Club, 1317 Spruce Street. The speaker of the evening was Lee Nusbaum, who gave an interesting talk on "Refrigeration."

NATIONAL ASSOCIATION of MASTER STEAM AND HOT WATER FITTERS

New York State Association.

New officers were elected as follows at the annual convention of the New York State Association of Master Steam and Hot Water Fitters, which was held in Buffalo, May 9: President, William H. McKiever, New York; vice-president, John R. Sheehan, Schenectady; secretary-treasurer, William J. Olvany, New York; board of directors: E. T. Childs, New York; Herman J. Brandeis, Utica; William J. Devendorf, Rochester; N. Loring Danforth, Buffalo, and Joseph D. Riley, Niagara Falls. The convention was opened by President N. Loring Danforth, and among the principal items up for discussion was the question of figuring overhead expense and a proposition to have manufacturers mark cast-iron fittings in a way that would indicate their source.

From data on the matter of overhead expense contained in a paper by President Danforth, it was learned that some members were figuring this item as low as 7½%, while others placed it at 22½%. The average figure, it was found, came to 16%.

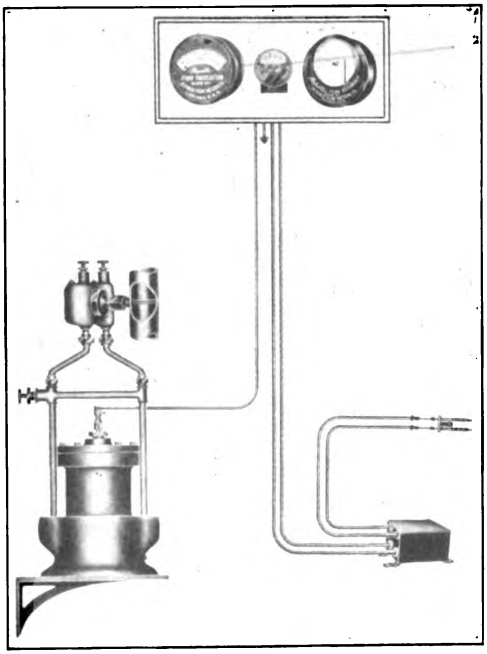
Following the convention, the Buffalo members entertained the delegates at a dinner at the Hotel Iroquois, the retiring president, Mr. Danforth, acting as toastmaster.

NEW DEVICES

A Meter That Registers Flow at a Distance.

A meter for measuring the flow of steam, water, air or gas, which can be placed at any desired distance from the pipe line, is an interesting device which has been perfected by the Republic Flow Meters Co., Chicago, Ill. The accompanying illustrations show how the connections are made for distance readings. The measurement is accomplished by means of a small electric current which is regulated by the flow of the liquid and is recorded on electrical instruments which, as stated, may be located at any distance from the pipe. In addition to measuring the current, these meters also register the amount of fluid passing through the pipe.

The installation as shown comprises a



REPUBLIC FLOW METER CONNECTED FOR DISTANCE READINGS.

regular transformer producing an initial low voltage circuit, which includes the instruments on the panel, the meter body and is completed through the ground. An averaging Pitot tube, inserted in the pipe where the flow is to be measured, transmits the pressure difference created by the flow to a mercury column in the meter body.

The rise and fall of the mercury engages and disengages suitable conductors regulating the amount of current flowing through the circuit. Accordingly, the total amount of electrical energy measured by the flow integrator is the exact equivalent of the total amount of fluid passing through the pipe, and the instantaneous flow of current shown by the indicator and recorder is equivalent to the instantaneous flow of fluid through the pipe. In this way all floats, cams, levers and gears are eliminated and there are no moving parts in the meter body.

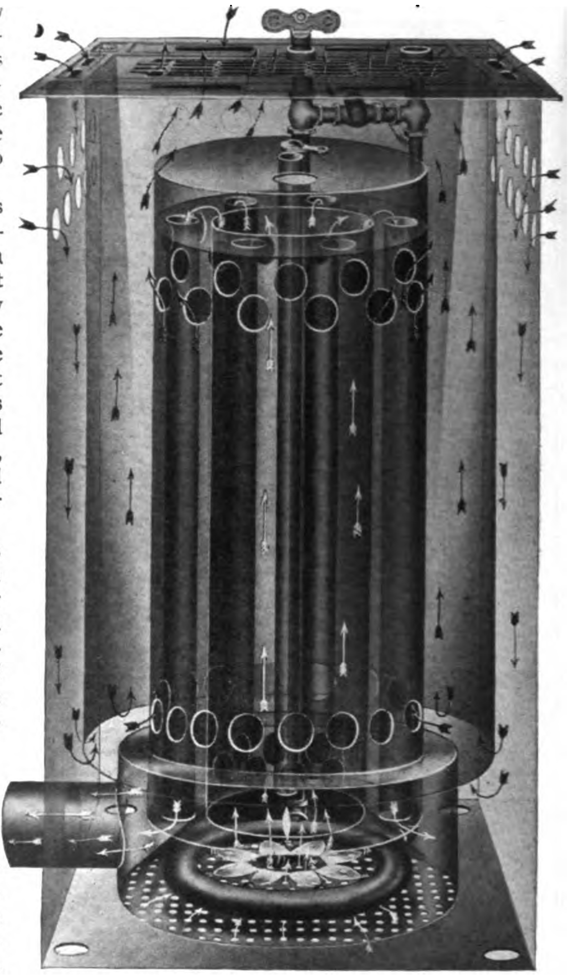
In a recent catalogue descriptive of this meter the details of construction are taken up at length, with views showing a number of diagrammatic applications, supplemented by a discussion of the fundamental principles of the Republic flow meter and of the Republic equal area Pitot tube. Size of catalogue (Bulletin 4) 8½ x 11 in. (standard). Pp. 20.

Unit Plant Hot Blast Heaters.

An apparatus which is termed a hot blast floor furnace, using gas for heating, has been brought out by the Unit Gas Heating Co., Los Angeles, Cal. It is described as the first circulating fresh air unit plant gas heating device on the market. The products of combustion are vented into a chimney or directly outdoors.

Each unit, it is claimed, will bring in a minimum of 5,000 cu. ft. of fresh warmed air each hour, these results being obtained on a consumption of 20 cu. ft. of artificial gas per hour or 10 to 12 cu. ft. of natural gas.

These units are built like the ordinary warm air furnace, but reduced in size. They are operated from the inside of the room. Each heater will warm from two to five rooms or from 3,000 to 7,000 cu. ft. of space. It has four thicknesses of metal and three air spaces of 1 in. each between fire and wood to make the heater fireproof. The burner is located about 20 in. below the floor. The heater is made in four styles, one with fresh air intake on side, for use in buildings having sufficient fresh air circulation under same, and another with intake at bottom, for use in buildings where it is desired to take air from outdoors. The other styles are built with wall registers, the size of the wall furnace front being 17 x 19 in., with a recessed portion of 14 x 17 x 4 in. between studding. The recessed portion has a 2-in. vent opening at the top, operated by a damper in front. Both the vent and fresh air intake pipes go between the studding.

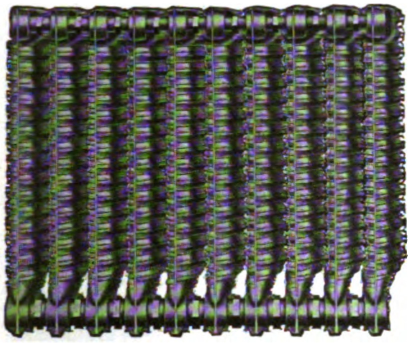

INDIVIDUAL HOT BLAST GAS FLOOR FURNANCE.

The Smith Hot-Blast Radiator.

The accompanying illustrations show the design and construction of the Smith hot-blast radiators, which have been placed on the market by the H. B. Smith Co., Westfield, Mass. These heaters have been under test by the company for some time and are now offered to the trade accompanied by performance figures covering temperatures and condensations for all sizes and with varying air velocities.

The design has been made with the idea

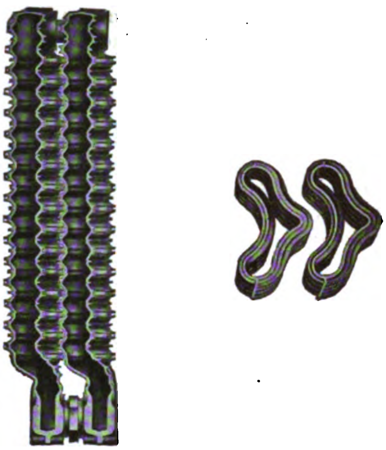
of having all air passing through the heater come into actual contact with either the prime surface or the slightly extended low rib surface. These ribs run horizontally around the heater.



SMITH HOT-BLAST RADIATOR.

The sections are designed so that they may be built up in tiers. Each radiator section is 9 in. wide, and they are made in 41-in., 51-in. and 61-in. heights, with spacings on centers of 5 in., 4⅝ in. and 5⅜ in. Their surfaces are, respectively, 10.75 sq. ft., 13.5 sq. ft. and 16 sq. ft.

The following table gives performance figures for a standard type, with spacing 5 in. center to center of section, based on steam at 227° F., 5 lbs. gauge and entering air above zero.



SECTIONAL AND PLAN VIEWS OF SMITH HEATER SECTIONS.

A New Boiler Meter Based on the Design of the Bailey Flow Meter.

The accompanying illustration shows a typical installation of the Bailey boiler meter, which is built on the general lines of the Bailey flow meter, described in last month's issue. It is described as really a combination of three separate meters in one

TEMPERATURES AND CONDENSATIONS, SMITH HOT-BLAST RADIATOR. REGULAR SPACING 5-in. CENTER TO CENTER OF SECTION.

Number of Stacks in Heater	Temperature of Entering Air	Velocity through heater in feet per minute Measured at 70° 100	100	150	150	200	200	600	600	800	800	1000	1000	1200	1200	1400	1400	1600	1600	1800	1800	2000	2000
		Final Temp. of Air Leaving Heater	Cond. per sq. ft. per Hour Lbs. Stm.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.	F. T.	C.
1	20	90	.44	86	.50	77	.72	60	1.50	56	1.80	53	2.05	51	2.29	49	2.48	46	2.62	44	2.71	43	2.88
	30	96	.41	92	.47	83	.67	68	1.43	64	1.69	62	1.96	60	2.25	58	2.39	55	2.52	53	2.60	52	2.75
	40	103	.39	99	.45	90	.64	76	1.35	72	1.59	70	1.86	68	2.06	66	2.22	63	2.32	62	2.48	61	2.62
	60	115	.34	112	.40	104	.56	93	1.19	88	1.39	86	1.60	84	1.75	83	1.95	81	2.11	80	2.25	79	2.37
	70	121	.32	118	.37	111	.52	99	1.08	96	1.28	94	1.47	92	1.60	91	1.77	89	1.91	88	2.02	87	2.11
2	20	133	.36	128	.41	115	.61	90	1.33	84	1.62	78	1.85	74	2.05	71	2.26	68	2.42	66	2.60	64	2.75
	30	137	.34	133	.39	120	.58	96	1.25	90	1.51	85	1.75	81	1.94	78	2.12	75	2.27	73	2.43	71	2.56
	40	141	.32	137	.37	124	.54	103	1.19	97	1.44	92	1.65	89	1.81	85	1.98	83	2.15	81	2.33	79	2.43
	60	149	.28	146	.33	134	.48	115	1.04	110	1.26	105	1.42	103	1.59	100	1.76	98	1.90	96	2.01	94	2.10
	70	153	.26	150	.30	139	.44	121	.96	117	1.18	112	1.32	109	1.47	107	1.62	105	1.74	103	1.84	102	1.97
3	20	162	.30	157	.35	143	.53	113	1.18	106	1.46	100	1.70	95	1.90	91	2.11	88	2.28	85	2.44	81	2.55
	30	165	.29	160	.33	146	.50	118	1.12	111	1.37	106	1.61	101	1.80	97	1.96	94	2.14	91	2.29	87	2.40
	40	168	.27	163	.31	150	.47	124	1.07	117	1.30	112	1.52	107	1.69	103	1.84	100	2.01	97	2.14	94	2.28
	60	173	.24	169	.28	157	.42	134	.94	127	1.13	123	1.33	119	1.49	116	1.63	113	1.77	111	1.91	106	2.03
	70	175	.22	172	.26	160	.39	139	.88	133	1.07	129	1.25	125	1.39	122	1.51	119	1.63	117	1.75	114	1.86
4	20							134	1.09	140	1.35	118	1.57	113	1.77	108	1.96	104	2.13	100	2.28	97	2.43
	30							138	1.03	144	1.27	123	1.49	118	1.67	113	1.85	109	2.00	105	2.14	102	2.27
	40							142	.97	148	1.19	127	1.40	122	1.56	118	1.73	114	1.87	111	2.02	106	2.14
	60							150	.86	155	1.06	137	1.24	132	1.37	128	1.51	125	1.64	122	1.76	120	1.89
	70							154	.80	159	.99	141	1.14	137	1.27	134	1.42	131	1.54	128	1.65	126	1.76
5	20							149	.98	140	1.23	134	1.44	127	1.64	123	1.81	117	1.99	113	2.12	110	2.26
	30							153	.94	143	1.17	138	1.36	132	1.55	127	1.71	122	1.88	118	2.00	115	2.13
	40							156	.88	147	1.10	142	1.29	136	1.46	131	1.60	127	1.77	123	1.89	120	2.01
	60							163	.78	154	.97	149	1.12	144	1.27	140	1.40	137	1.56	133	1.66	130	1.73
	70							166	.74	158	.90	153	1.04	148	1.18	145	1.31	142	1.45	138	1.54	135	1.62
6	20							161	.90	152	1.13	146	1.34	140	1.53	134	1.69	130	1.86	126	2.01	122	2.14
	30							164	.86	155	1.07	149	1.27	143	1.44	138	1.60	134	1.76	130	1.90	126	2.02
	40							167	.81	158	1.00	152	1.19	147	1.27	142	1.51	138	1.65	135	1.80	131	1.91
	60							172	.72	164	.88	159	1.06	154	1.19	150	1.33	146	1.45	143	1.57	140	1.67
	70																						
7	20							172	.84	164	1.05	157	1.25	151	1.43	144	1.59	140	1.74	136	1.90	132	2.05
	30							174	.79	166	.99	158	1.19	154	1.35	147	1.50	143	1.64	139	1.78	136	1.92
	40							175	.75	169	.94	161	1.12	158	1.28	151	1.43	147	1.55	143	1.66	140	1.81
	60																						
	70																						
8	20							180	.77	172	.97	166	1.16	160	1.34	155	1.50	150	1.64	145	1.78	141	1.91
	30							182	.73	174	.92	168	1.10	163	1.27	158	1.42	153	1.55	148	1.66	144	1.80
	40							184	.69	176	.87	170	1.03	165	1.19	160	1.33	156	1.46	151	1.58	147	1.69
	60																						
	70																						

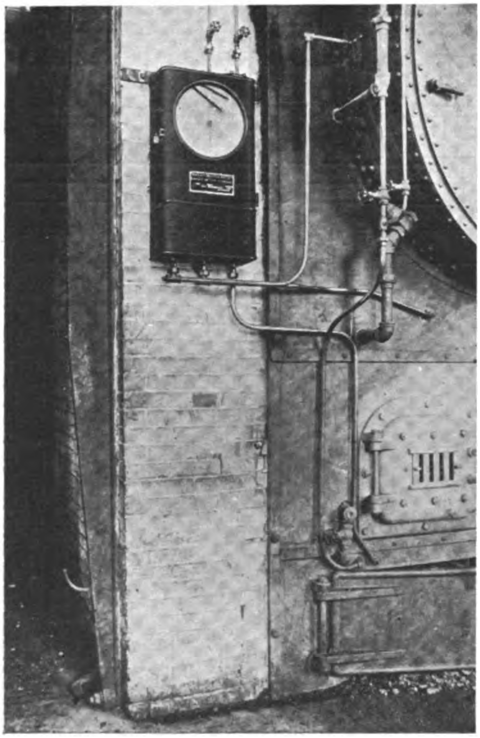
*Unless otherwise specified Radiators will be shipped with R. & L. Nipples for regular spacing (5" Centers).

Steam 227° F. 5 lbs. Entering Air Above Zero.

casing, each drawing its own record in a distinctive color on a 12-inch chart. The meter records (1) the rate of steam output from the boiler; (2) the rate of air flow through the furnace; and (3) the condition of the fuel bed. The meter also correlates and compares these factors in a way that is easily understood by the fireman at the same time giving him information for making any necessary changes in the furnace or draft conditions.

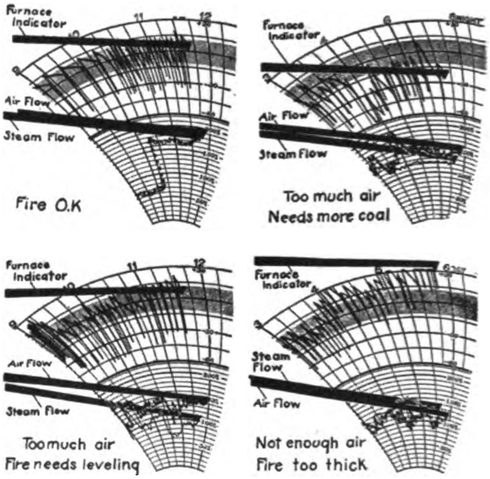
The steam flow is recorded by a red pen drawing a red record in the center section of the chart, the graduations being in per cent. of the boiler's rated capacity on a uniform scale. This part of the meter is identical with the Bailey steam meter. It operates upon the principle of measuring the pressure difference across a Monel metal orifice placed in a flange of the steam line.

The air flow is recorded by the blue pen traveling just ahead of the steam flow pen. This pen is operated by the draft differential between the firebox and the uptake, but instead of reading in terms of draft, it reads in terms of steam output. Thus it draws a coincident record with the steam flow so long as the right amount of air is used for combustion.



BAILEY BOILER METER INSTALLED.

The furnace indicator drawing a record on the outer section of the chart shows the conditions of the fuel bed. The fire is of the right thickness when this pen is on the shaded band. It is operated by draft pressures and is really a measure of the resistance of the fuel bed to the flow of air. This meter is made by the Bailey Meter Co., Boston, Mass.



HOW TO READ THE BAILEY FLOW METER.

The New Mason Condensation Meter.

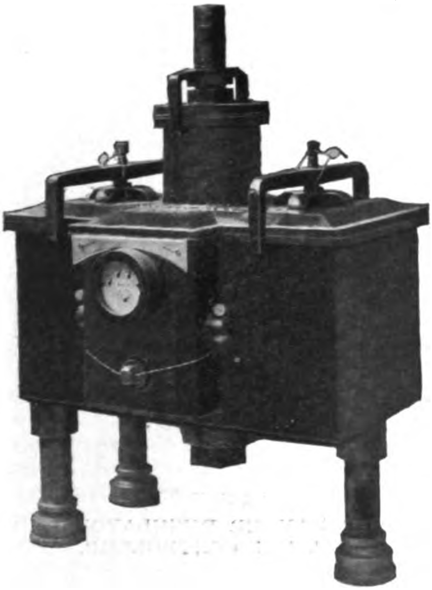
A meter adapted for measuring liquids and condensed steam and described as an improvement fulfilling the needs of reliable record, simple construction and reduction in cost of operation, has been brought out by Gilmore Mason, superintendent of the uptown system for the New York Steam Co., 105 East 63d Street, New York. It was on view for the first time at the recent convention of the National District Heating Association, in New York.

Mr. Mason has had many years' experience in connection with meter testing and experiments and his new device is a direct result of this experience, his purpose being to perfect a design that requires the minimum in meter maintenance.

Five features of the Mason meter contribute to this end: (1) the inlet tank, consisting of water and sediment deflector; (2) outside access to adjusting screws; (3) simple operation of locating the original adjustment points, made possible by the use of an adjusting key which is connected to the bucket shaft by inserting the key through the opening immediately under the counter housing; (4) the arrangement of the water deflectors on the inner side of the bottom of the meter casing which causes a splash of water over the bearings during each discharge of the dumping buckets; (5) the three bosses projecting from the bottom of the casing and tapped for 1¼-in. nipples, affording the major portion of a shelf or stand to support the meter body. The purpose of the three legs is to make the setting of the meter similar to a tripod.

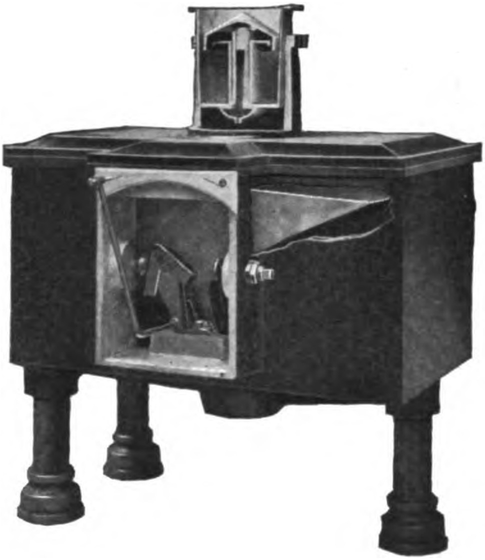
The original calibration and adjustment points are established at the shop or testing room, which is the only occasion necessary requiring the use of water for testing. The adjustment positions are located on the gauge or plate, found immediately over the counter housing. They are spaced 1-16-in. apart, indicating variations of 2 per cent. point to point. When the key is inserted for adjustment reading, such readings are made from the end of the plate toward the center. A record of the number of points for each side is made, indicating the original or correct adjustment. The serial number of the meter is noted at the same time.

The meter is intended to remain in place permanently after it is installed for service. At the end of the season the inspector uses the adjusting key for testing and, if the adjusting gauge shows correction in adjustment necessary, the caps over the adjusting screws are removed for the purpose of manipulating the screws to restore the original adjustment. This covers a period of time of about 5 min. and is all done from the outside of the meter casing.



THE MASON METER.

The inspector should next examine the sediment tank, indicated above as the inlet tank. The nut supporting the clamp on the inlet neck is released and, if the meter is properly connected, the inlet cover can be raised to allow removal of the sediment tank for cleaning. The maximum time, it is stated, for this operation, should not be over 5 min.

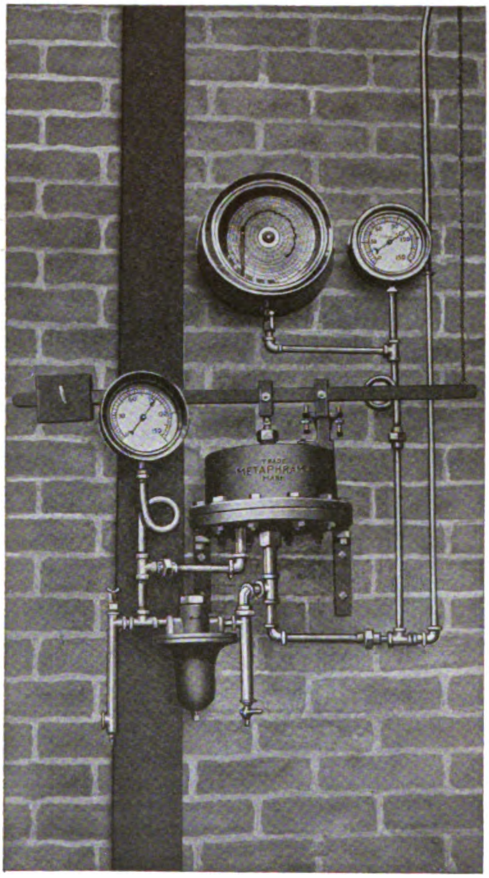


CONSTRUCTION OF MASON METER.

It is pointed out that the methods above described are all that are necessary for the season's overhauling. This eliminates such features as cleaning meter parts, or body. This saving is due to the fact that at each discharge of the dumping bucket the inside body of the meter is washed and, with the assistance of the water-lubricating deflectors located at the bottom, a splash of water is carried over the bearings, keeping them automatically and constantly lubricated. In this way the use of oils or grease is avoided.

The meter, in short, is described as a product that comprises a four-in-one combination, consisting of (1) a complete liquid meter, (2) a sediment trap, with its own accompaniments, (3) an automatic lubricating device and (4) the major portion of a supporting shelf.

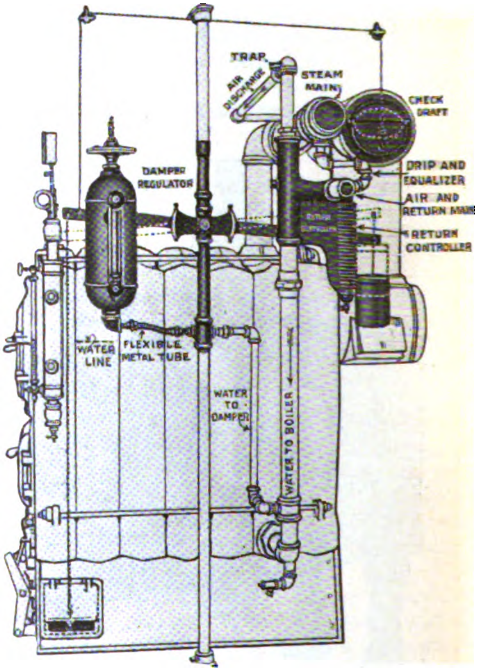
Trade Literature.



TYPICAL INSTALLATION OF METAPHRAM HIGH PRESSURE STEAM DAMPER REGULATOR.

Metaphram High Pressure Steam Damper Regulators, described as a new departure in high pressure fields, are illustrated and described in newly-issued circular matter issued by the National Regulator Co., Chicago, Ill. They are described as simple, sensitive and direct-acting, automatically operating a balanced draft damper on a slight variation of steam pressure. This device is designed for boiler pressures from 15 to 175 lbs. It requires no auxiliary power and has no packings, perishable or wearing parts. As may be noted from the illustration, it can be installed like any low pressure regulator or on brackets at any convenient point. Boiler pressure is admitted direct to the inside of the diaphragm and the outside of the diaphragm through a strainer and reducing valve. If the pressure to be carried is, say, 100 lbs., the reducing valve is set to close at the same pressure. Therefore, when the boiler pressure increases, it builds up on the inside of the diaphragm, thus gradually inflating it and actuating the lever controlling the damper. Condensation is discharged by means of a small trap and drip pipe run to the ash pit. The point is emphasized that this damper regulator is absolutely graduated in its action. It is provided with adjustable fulcrum and sliding lever.

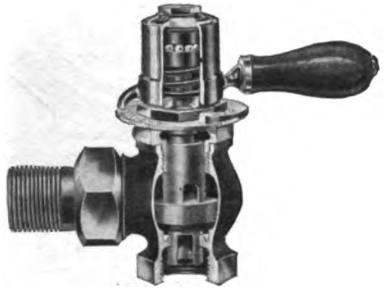
Turner Damper Regulator and Controller, to be attached to a steam boiler and designed to positively control the chimney check draft and thus maintain any uniform pressure desired in the boiler, is a unique attachment described in a new circular issued by the Turner Heating Co., 143 Eddy Street, Providence, R. I. This device can be connected to an apparatus already installed, as well as to a new apparatus. It is so constructed that vapor or pressure forces water from the boiler into the receiver. The weight of the water closes the dampers and as the pressure goes down, the water flows back into the boiler when the dampers will open. The amount of vapor or pressure is determined by the height of the receiver above the water line in the boiler. It is stated that the return controller can be used on one-pipe loop



TURNER DAMPER REGULATOR AND RETURN CONTROLLER.

systems to eliminate air and fill the entire loop main with steam, making the remote radiators heat quickly. In vapor heating, condensation and air are separated in the controller, the condensation returning to the boiler and the air to the chimney, through a trap, as shown in the accompanying illustration. In severe weather the return controller makes it possible to increase the efficiency of a vapor installation by raising and using steam pressure. Full directions for installing are included in the circular.

Dole Graduated or Modulating Valve, described as the ideal valve for vacuum or vapor steam heating, is brought to the attention of the trade in new circular matter received from the Dole Valve Co., 208 North Fifth Avenue, Chicago, Ill. This valve, which is 4⅜ in. high, is packless and ball-bearing. It is designed as a marked improvement over other styles of modulating valves and has been the object of several years of experimenting by the company. The graduated sections are made in various sizes to meet all requirements of radiation. In case of a desired adjustment after the valve is fitted and installed, it is only necessary to loosen the octagon nut on top of the dial with a special wrench furnished for the purpose, turn the dial to the left to the desired point and then tighten the nut. In this way it is possible to have with this valve every degree of opening required in vacuum or vapor steam heating. This adjustment may be made without interfering with any of the working parts of the valve and while the steam is on. The company states that over a quarter of a million Dole valves are in use and in not one has the packless disc been changed.



NEW TYPE OF DOLE GRADUATED OR MODULATING VALVE.

Connersville Vacuum Cleaners are the subject of a new catalogue published by the Connersville Blower Co., Connersville, Ind., in which this company has sought to give "Connersville" purchasers the advantages of the company's nine years of experience in this field. The company states that for ordinary conditions one of its standard units can be selected to give any cleaning results desired. For special conditions the company maintains a staff of engineers who are prepared to work out an equipment to carefully meet any given specifications. The necessary data are included in the catalogue and this is followed by a number of representative Connersville installations, some of them being accompanied by testimonials showing the satisfactory service given by this equipment.

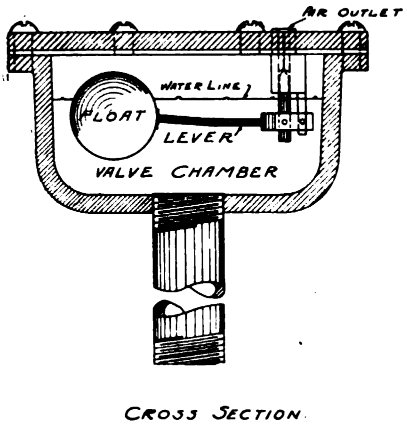
Ingersoll-Rogler Vacuum Pumps, which it is stated, are rapidly superseding direct-acting pumps for high efficiency and economy, are attractively presented in a new circular issued by the Ingersoll-Rand Co., 11 Broadway, New York. It is also stated that they embody features heretofore unattainable in vacuum pumps, such as high vacuum, the economical maintenance of any desired degree and the handling of discharge pressures of several pounds. They are equipped with the "Ingersoll-Rogler" inlet and discharge valves which permit of high rotative speeds. These valves are multiported, giving large valve areas, are automatic in action, have a low lift for a given port opening and require little power to operate. Flash ports in the cylinder walls are included to prevent the building up of pressure to prematurely open the valves, thus making possible a high volumetric efficiency. Attention is also called to the comparatively small floor space required by this type of compressor.

Gorton Quarter-Turn Packless Valves, designed for all systems of steam, hot water, vapor and vacuum heating, which were described at length in the April issue, are the subject of a new catalogue, issued by the manufacturers, the Gorton & Lidgerwood Co., 96 Liberty st., New York. The quarter-turn type for radiators is made in four sizes and two styles, and the straightway type also in four sizes and two styles. The straightway type is also made with unions. A table of dimensions of each type is included. Size 3½ x 6 in. (standard). Pp. 16.

Evolution of Hand Pipe-Cutting Tools, being a reprint of an article written by W. A. Phillis, is being sent out by the Borden Co., Warren, O., the company at the same time calling attention to the Beaver square-end cutter, which is described as "the last step in the evolution of hand pipe-cutting tools." It is stated that this cutter will give a perfect square-end cut without burr, inside or outside. It is made in two styles, one for use with pipe running from ⅛-in. to 1 in. in diameter, and the other for pipe from ½ in. to 2 in. in diameter.

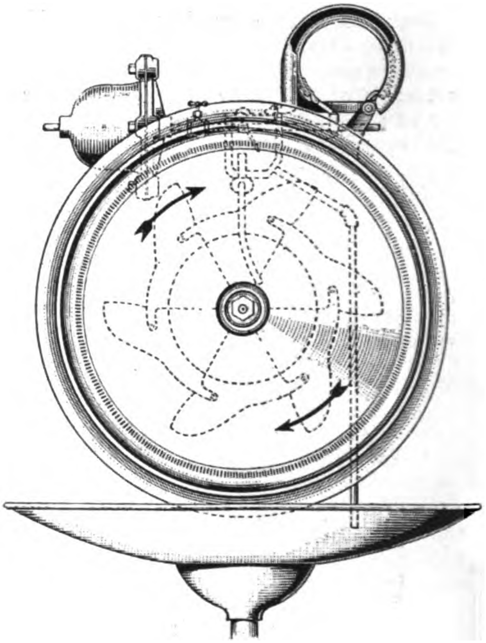
Hutchison Fitter, containing the necessary data to enable engineers, architects and heating contractors to select the proper sizes of the various appliances which make up the Hutchison system of vapor heating and to properly assemble such appliances, has been published by the Hutchison Vapor Heating Corporation, Washington, D. C. The booklet is essentially practical and takes up each appliance in detail, as well as showing views of typical installations. A special section is devoted to locating troubles in a system while another section takes up "Converting Existing Systems," the catalogue closing with a general form of specification. Size 3½x6 in. (standard) pp. 40.

King Automatic Air Valve for hot water heating systems is a unique product of the King Construction Co., North Tonawanda, N. Y., described in the company's Leaflet No. 9. This valve does not depend on the heat of the system to close it, but on the lifting power of the water acting on a hollow copper float. The collection of air in the valve chamber allows the float to drop slightly and this lowering of the float, acting through the lever, opens the air outlet. As the air passes out, the water rises in the valve chamber, lifting the float and thus closing the air outlet and preventing the water from escaping. The circular includes dimensions and instructions for installing. This company is also the manufacturer of the King Richon (K. R.) hot water heating system and the King system of pressure equalizing mains. The striking feature of this system is that in a steam boiler carrying steam, the water from the boiler is circulated through the heating pipes, instead of the steam.

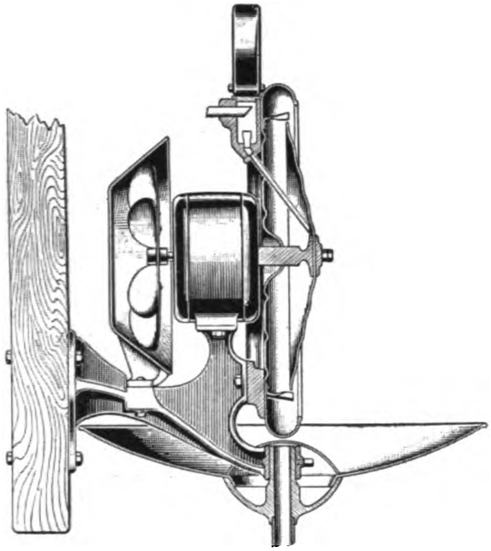


KING AUTOMATIC AIR VALVE FOR HOT WATER HEATING.

Normalair Patented Humidifiers, manufactured and sold by the Normalair Co., Winston-Salem, N. C., are the subject of a new catalogue in which the construction and operation of this unique apparatus is described in detail. In this device, the water is reduced to fine particles, or fog, by mechanical means, within the machine itself, and since it is necessary only to feed water at any available pressure to the humidifier, and to conduct the waste to any convenient drain, each Normalair humidifier constitutes a complete humidifying unit. The water enters the humidifier from above and passes into the regulator chamber. From this point, depending on the automatic control, it passes directly to the center of the rapidly-revolving disc from which it is thrown by centrifugal force against the teeth of a copper grid at the circumference of the disc, where it is pulverized. The speed of the disc is sufficient to give the equivalent of over 100 lbs. pressure to the square inch on a thin film of water. Behind the device is a fan which forces the evaporation, as well as circulating the moistened air. Each unit is also equipped with an ingenious automatic humidity control. The complete apparatus is a development of the Hygrosso humidifier, which was on the market some years ago. The company



FRONT VIEW OF NORMALAIR HUMIDIFIER.



SECTIONAL VIEW OF MOTOR-DRIVEN NORMALAIR HUMIDIFIER.

is also sending out the figures of a test of a Normalair humidifier made in a room containing about 22,000 cu. ft. of space. The room was not heated, although the remainder of the building was. The humidifier ran day and night, with automatic control, without being touched, for nearly a month. The variation of room temperature was 18° F.; outdoor temperature variation, 35° F.; outdoor humidity variation, 55%; indoor humidity variation, 4%. Size of catalogue, 5½ x 9 in. Pp. 8.

An Example of Unit Classroom Heating and Ventilating.

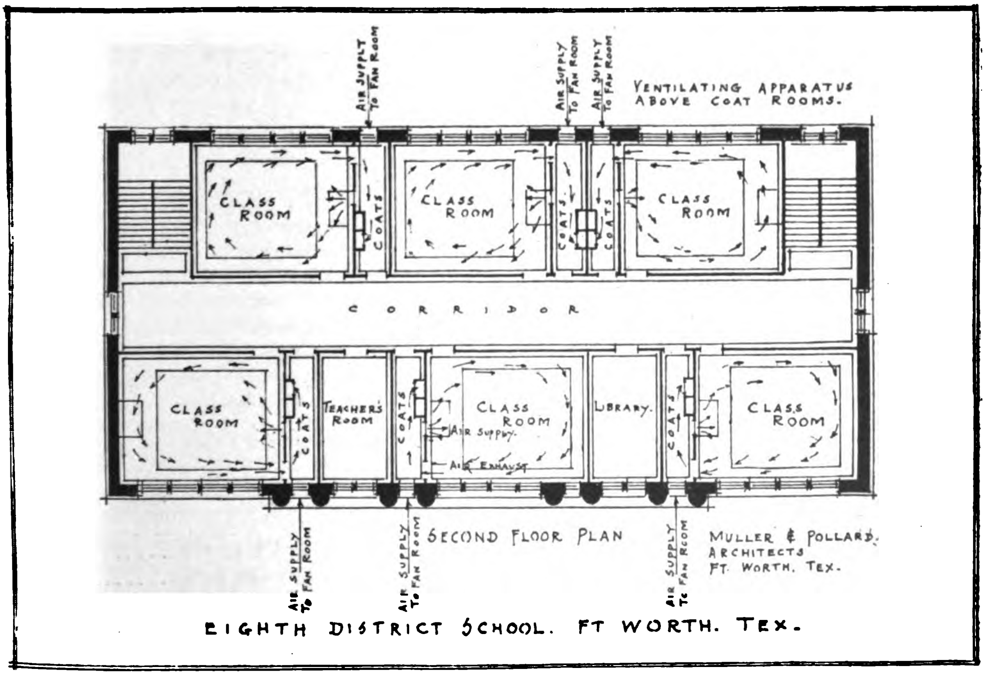
A rather unusual design of unit classroom heating and ventilation has been installed in two of the Fort Worth, Tex., schools, Mullard & Pollard, architects. Superintendent J. W. Cantwell co-operated actively in working out the ideas, which are the subject of an article in the American School Board Journal.

In the scheme in question the cloakrooms were divided horizontally, using a space 7 ft. high for the ordinary storage of children's clothing, and fitting the upper space for a small ventilating plant. Since the story height of the buildings is 13 ft., this arrangement was found entirely practical.

The windows in the coatroom were also divided and the upper halves were fitted with louvres. Through these louvres fresh air is drawn into the ventilating chamber over a series of steam heated coils, by a large electrically-driven fan. From the fan the air is forced through a diffusing outlet, placed about 7 ft. 6 in. above the floor line, into the classrooms.

The foul air from the classrooms is exhausted through a vent shaft located in the cloakroom, the door of the cloakroom being raised 18 in. from the floor line so that the air from the classrooms may freely circulate toward the exhaust register. The air flows up the vent shaft by natural draft.

It is stated that the operation of the



SYSTEM OF UNIT CLASSROOM HEATING AND VENTILATION.

fans was made entirely noiseless and the control of the fans is at all times in the hands of the teachers through the use of push buttons.

◆

Co-operation Program for Engineers.

As showing more definitely the lines on which the committee on engineering co-operation of the principal engineering societies will work, the full text of the resolutions, as passed at the conference, are given herewith:

Whereas, The rapid increase in engineering activity of recent years has given rise to many problems vitally affecting the practice of engineering, and

Whereas, Existing agencies, through lack of proper correlation, appear inadequate for the solution of these problems; and in order that the resources of the profession may be made available for the most useful service to the nation, state and municipality, and that the practice of engineering may be rendered more efficient and less burdensome in those places where its development has been most difficult, and

Whereas, It is the sense of the Second Conference on Engineering Co-operation, representing societies, national, state and local, and comprising various branches of engineering, that these ends may be attained throughout a closer association and co-operation of engineering societies.

Be It Resolved, That there is hereby established a sub-committee, with F. H. Newell as chairman, and four other members to be selected by him, with instructions to prepare a plan for forwarding co-operation among engineering societies upon matters of general interest to the engineering profession, such plan to be presented for formal consideration at a third conference on engineering co-operation to be called by the sub-committee at such time and place as may seem to it desirable.

Be It Further Resolved, That the several organizations represented at this conference should be permitted to assist in defraying the expenses of the Committee on Engineering Co-operation and that the sub-committee should be requested to present to each of the societies represented an estimate of probable expenditures, including clerical service, together with recommendations for equitable pro-rating.

Be It Further Resolved, That this conference express its high sense of appreciation for the courtesies and hospitality extended by the Western Society of Engineers, Sub-Division 63 of the Chicago Association of Commerce and the Chicago Engineers Club, and hearty thanks therefor are hereby expressed.

Committee on Resolutions,
Paul Hansen, Chairman;
John Howe Peyton,
Albert J. Himes.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JULY, 1916

Air Conditioning in a Gas Mantle Plant

Equipment of the General Gas Mantle Company, Camden, N. J.

Standardization of product and reduction of costs are among the chief efforts of every manufacturer, but the successful fruition of those efforts is frequently affected by an important, but too often neglected, factor. That factor is the all-pervading atmosphere, the well-known vagaries of which it is needless to dwell upon.

Considering its relativeely intangible nature is it not strange, perhaps, that it should be overlooked, yet it may be stated without fear of contradiction that every industry is adversely affected in some measure by the wide annual range of atmospheric characteristics.

The importance of temperature has always been taken into account and its annual range indoors artificially restricted to a large degree, but the more subtle element—humidity—has been allowed to rove in its natural wildness. The relations of temperature and humidity to the efficiency and well-being of man are quite generally recognized, but their effects upon materials, manufacturing processes and the uniformity, quality and quantity of production have been very generally overlooked, though it must be said that consideration is being given it now in a rapidly increasing measure.

PROBLEMS IN CONNECTION WITH MANUFACTURE OF GAS MANTLES.

It is of interest in connection with the foregoing remarks to consider the case of the General Gas Mantle Company of Camden, N. J.—manufacturers of incandescent gas mantles—who were pioneers in the realm of air conditioning as related to their particular industry, and to note briefly the considerations which moved them to investigate the feasibility and merits of controlling atmospheric conditions.

1. The output of the factory was greatly curtailed and at times stopped during hot weather, owing to the impossibility of keeping the women operators at work during such times — a rather superior grade of labor being employed in this plant.

2. At certain stages of the process, the contamination of the mantles by dust and dirt resulted in "pin holes" in the product, necessitating its rejection.

3. When certain atmospheric conditions prevailed—chiefly the combination of high temperature with high humidity —the uniformity, shape and quality of the mantles were seriously affected. The nature of the action was not understood, nor the limits within which trouble was experienced well defined, but it is noteworthy that the chief materials entering into the construction of mantles, namely, vegetable fibre and thorium salts, are extremely hygroscopic.

The absence of definite information in

relation to the third point precluded a proper analysis of the situation, so that it was finally decided to install equipment which would afford a wide range of temperature and humidity to admit of experimental determination, on a commercial scale, of the most favorable conditions for satisfactorily solving all the problems presented.

PRINCIPAL PROCESSES OF MANUFACTURE.

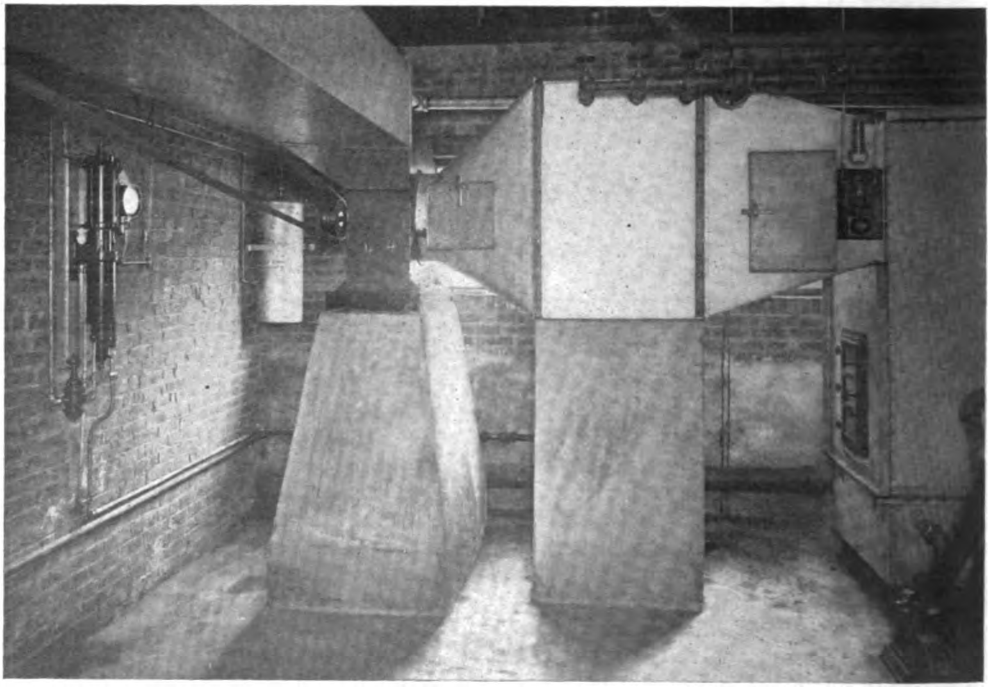
Briefly, the major processes in the manufacture of gas mantles are:

1. Knitting the tubular fabrics from cotton, or a mixture of cotton and ramie yarns.
2. Thoroughly washing and drying the fabrics.
3. Impregnating the fabrics with a solution containing the rare salts which give the mantle its incandescent properties.
4. Shaping and mounting the fabrics.
5. Burning out the organic elements of the fabric over gas flames, leaving the fragile ash skeleton.
6. Dipping the ash skeleton into an inflammable collodion and then drying; this permits handling and shipment of the mantle without danger of breaking, and this is the coating which must be burned off by the purchaser before the mantle is put in service.
7. Final mounting and packing.

The rooms in which processes No. 4 and No. 6 are carried out are supplied with conditioned air.

THE SHAPING ROOM.

The shaping room is in the second story of a three story building; the east and west wall are exposed, a considerable portion of the gross area being glass in metal frames. All walls, except the south, which is formed by a matched board partition, are 18 in. brick. The floor is of mill construction. About 60 operators do hand-work exclusively in this room, which is supplied with an air volume sufficient to maintain in summer a temperature as low as 75° F., with an outside temperature of 100° F.; at this room temperature a specified relative humidity is maintained. In winter also the same temperature and humidity can be maintained with 0° F., outside.



FAN, HEATER, AIR COMPRESSOR, DEW POINT THERMOSTAT AND TANK, PLANT OF GENERAL GAS MANTLE CO., CAMDEN, N. J.

Up to 80% of the maximum air volume delivered to the room may be recirculated, this being manually controlled during a part of the year and automatically regulated the balance of the time, as described hereinafter.

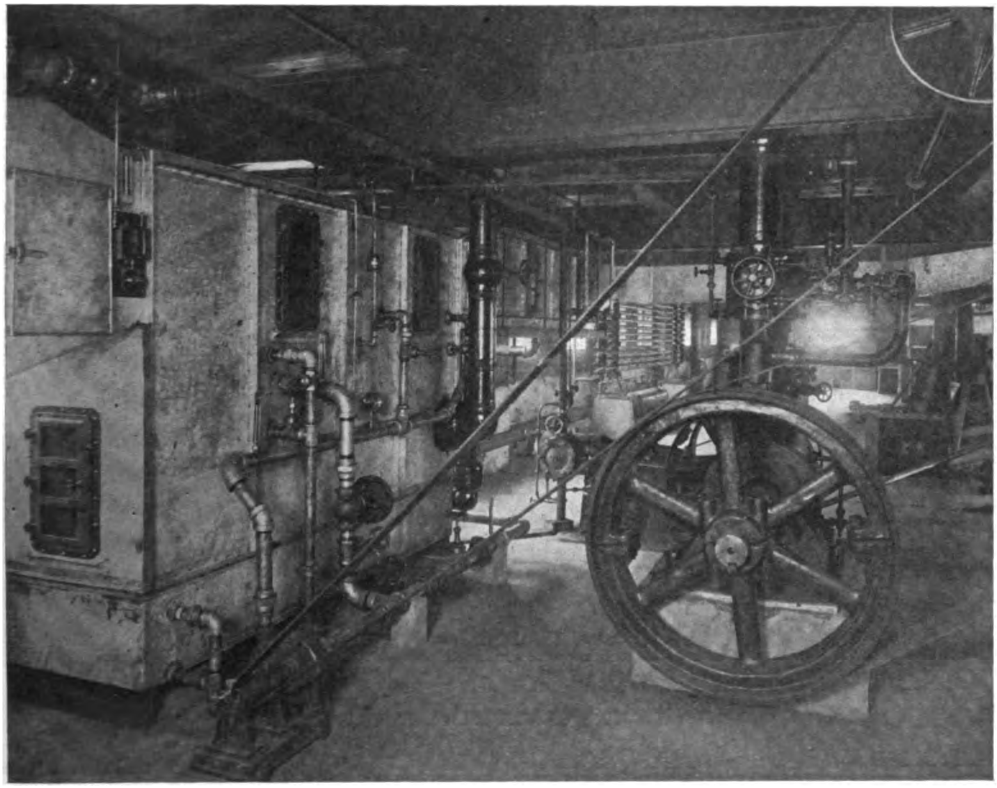
THE DIPPING AND DRYING ROOM.

Directly above the shaping room is the dipping and drying room, a tight enclosure, the ceiling and walls of which are made of asbestos board to render them fireproof. The floor is metal covered and there are no windows or exposed walls. The air supply is brought into the room from an opening in the ceiling of the shaping room. The air is distributed overhead, and vent outlets located in the floor connected to an exhauster in the basement remove it and discharge it outside, as the acetone absorbed from the collodion in the drying process make it unfit for recirculation.

UNIQUE AIR CONDITIONING EQUIPMENT INSTALLED.

The air conditioning equipment is unique, not in point of magnitude, but as an illustration of the high development which the art has attained.

The air is passed through two Webster special dehumidifiers in series, in the first of which cold well water is sprayed and in the second refrigerated water is used. The temperature and dew-point of the air leaving the second dehumidifier is thermostatically controlled. The air then passes through a reheater and is warmed as required to keep the shaping room at the proper temperature, a thermostat in the room automatically regulating this. From the reheater the air passes into the fan, thence to the rooms. All the air conditioning equipment is in the basement.

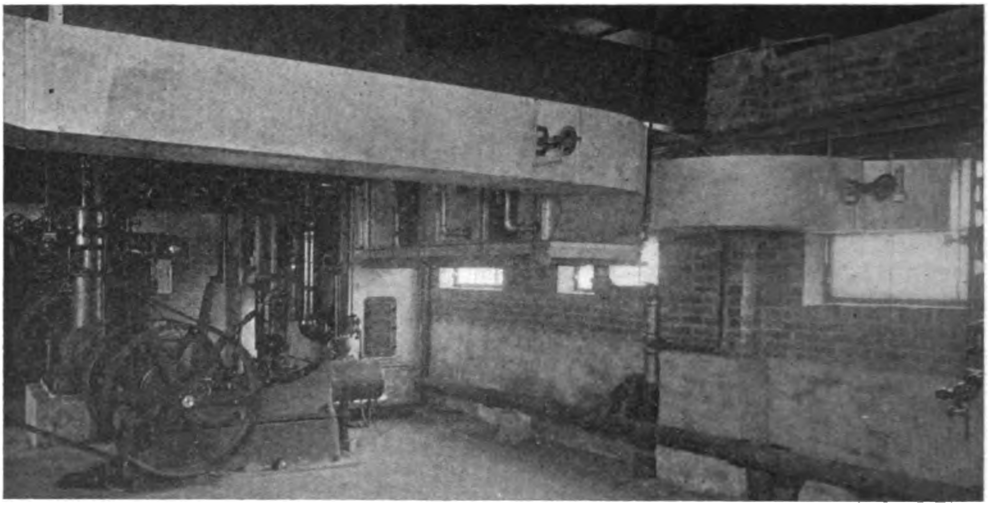


GENERAL VIEW OF AIR CONDITIONING PLANT, GENERAL GAS MANTLE CO., SHOWING DEHUMIDIFIERS, AMMONIA COMPRESSOR, CONDENSING COILS, ETC.

ARRANGEMENT OF FIRST DEHUMIDIFIER.

Both dehumidifiers are built of galvanized American Ingot iron, braced with 1½-in. galvanized angles. The first dehumidifier is supported on a wooden platform suspended from the ceiling by iron rods, an arrangement which it will be seen from the photographs makes for accessibility and economy of space. The spray chamber casing is equipped with ample-sized glass-paneled doors, which, with a vapor-proof marine light within the spray chamber, renders access and inspection easy.

Well water at 52° to 54° F. is sprayed into the air through brass spiral mist nozzles, arranged in two equal headers, the water being discharged in the direction of air flow by those nearer the entrance to the spray chamber, the balance being opposed thereto. This water, after washing and cooling the air, falls into a pan 6 in. deep, extending under the entire apparatus, from which it drains through an open overflow and running trap to sewer. After passing through a low resistance eliminator in which all free moisture is removed, the air leaves this apparatus and passes into the second dehumidifier at a temperature of about 63° F., depending upon the outside weather conditions and the amount and condition of the air recirculated.



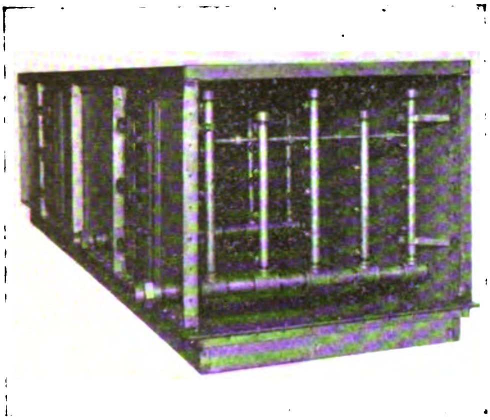
FRESH AIR AND AIR RETURN DUCTS TO DEHUMIDIFIERS, PLANT OF GENERAL GAS MANTLE CO. (NOTE AUTOMATIC DAMPERS.)

An artesian well was sunk especially to secure water for this apparatus and it is taken from the well by a power pump and delivered to a tank placed on the roof of the building, which maintains a steady pressure of 20 lbs. at the spray nozzles in the dehumidifier; this arrangement secures the coldest water at the dehumidifier where its maximum refrigerating effect is desired.

ARRANGEMENT OF SECOND DEHUMIDIFIER.

The second dehumidifier is a double compartment arrangement, supported on I-beams. The upper compartment forms the spray chamber, which is of the same shape and size as that of the well-water dehumidifier, and encloses the eliminator and two equal, opposed headers of mist nozzles. The lower compartment encloses a Baudelot coil for cooling the spray water and consists of 275 lin. ft. of 2-in. pipe arranged in six rows and six pipes high; it is fitted with slotted pipe water distributing troughs with leveling devices, expansion valves, supporting stands, etc. Both compartments are equipped with glass-paneled doors and the upper one with a marine light; the end plates of the lower compartment are removable, thus the whole apparatus is readily accessible.

Tanks 15 in. deep extend under both compartments and each is equipped with a ball float valve for admitting fresh water as required for filling and to keep the water line constant, a removable



FIRST DEHUMIDIFIER DESIGNED FOR USE WITH ARTESIAN WELL WATER.

double-box perforated brass strainer completely submerged for guarding the outlet to the pump, and a valved drain to sewer. The lower tank has an open overflow, while the upper tank has a valved overflow the level of which is about one inch lower than that of a series of hooded overflows connecting into the water distributing pipes in the lower compartment. The ball float valve is adjusted to maintain a water line level with the valved overflow, but when refrigeration is being used the valve in the overflow is closed and the water line stands level with the overflows to the distributing pipes, so that any excess of water coming into the system by reason of the condensation of moisture from the air is ultimately relieved through the overflow of the lower tank.

When refrigeration is not being used the valved overflow is kept open and thus no water escapes to the lower compartment.

A centrifugal pump maintains the proper pressure on the spray nozzles and is so connected to the dehumidifier that it can draw from either tank or both, as required, to keep the air at the proper dew-point.

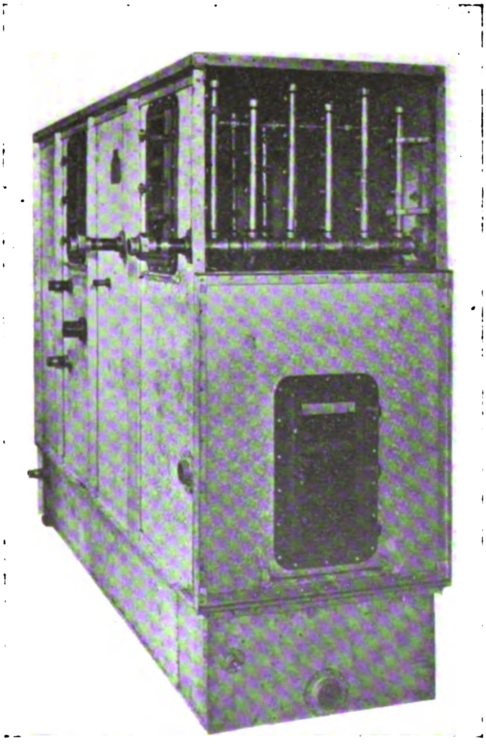
REFRIGERATING EQUIPMENT.

Refrigeration is supplied by a Vilter 9 in. x 9 in. vertical single-acting ammonia compressor operating at about 99 r.p.m., having a maximum capacity of 12 tons at a head pressure of about 125 lbs., and a suction pressure of about 35 lbs. This is equipped with oil separator, double pipe counter-current condenser and ammonia receiver. The condenser is 12 pipes high, 21 ft. long, inner pipes 1¼ in., outer pipes 2 in. Water is supplied from the roof tank at the maximum rate of 15 gals. per minute. No speed regulation of the compressor is possible and it accommodates itself to the carrying requirements by decreasing the suction pressure as the work demanded drops, which obviously increases its capacity and power consumption.

EXHAUST STEAM USED TO HEAT AIR.

The main reheater consists of 3 rows of 40-in. regular pattern Vento radiation dipped in asphaltum, each row containing 5 sections on 5-in. centers. Each row has an independent supply valve and is dripped through a Webster water seal trap into the vacuum return. A single diaphragm valve regulates the supply of exhaust steam to the entire heater in accordance with the demands of the shaping room thermostat.

The fan is a No. 3 full-housed Niagara-Conoidal type and operates at 800 r.p.m., against 1-in. static pressure.



FRONT VIEW OF SECOND DEHUMIDIFIER.

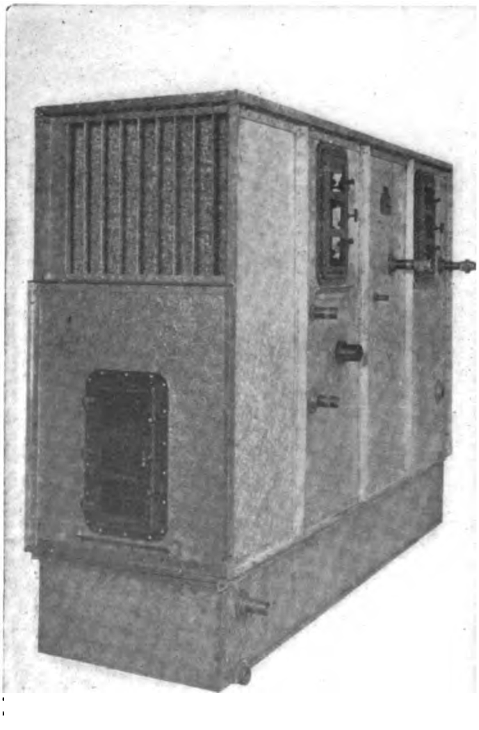
The ammonia compressor, dehumidifier pump and fans take power from a line shaft and countershafting driven by a Vim steam engine operating at 266 r.p.m., the exhaust being used in the reheater. The driving pulley for the compressor is of the clutch type.

The Johnson system of temperature regulation is used, compressed air being furnished by a hydraulic compressor; thermostats are of the graduated-acting type.

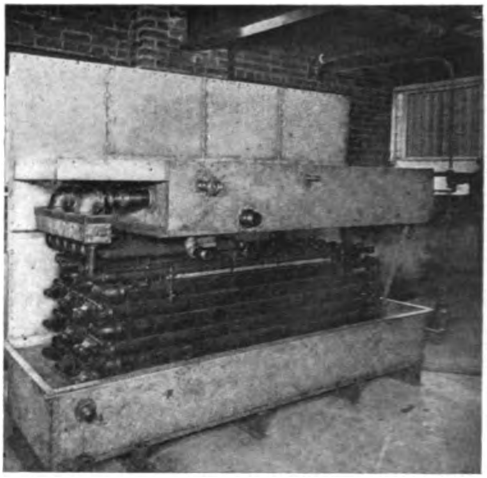
HOW THE SYSTEM IS OPERATED.

The system may be operated in one manner during the entire year, but in order to effect the economies possible some variation is necessary. Whenever the wet-bulb temperature outside exceds that in the shaping room the maximum amount of air is recirculated, sufficient fresh air being admitted through a by-pass damper to make up for that supplied the dipping room. Under these conditions both dehumidifiers must be used and well water and refrigeration expended.

The final dew-point of the air, which may be kept as low as 40° F., is maintained constant by a duct thermostat located at the air washer outlet which operates interacting- diaphragm valves in the suction lines from the upper and lower tanks of the second dehumidifier. Thus the proportions of cooled water from the latter and warmer water from the former are so regulated that the water issuing from the nozzles has the exact temperature necessary to cool the air to the proper degree. The valve in the line from the upper tank is "normally open" and the other "normally closed." A check valve in the latter line prevents a possible backflow of water from the upper to the lower tank.



REAR VIEW OF SECOND DEHUMIDIFIER.



INTERIOR OF SECOND DEHUMIDIFIER, SHOWING UPPER AND LOWER TANKS, BAUDELOT COILS, OVERFLOW AND WATER DISTRIBUTING ARRANGEMENT.

When the outside wet-bulb temperature is at any point between the wet-bulb temperature of the shaping room and that of the well water, it is economical to take all air from outside, and still operate the dehumidifiers as for the previous condition.

When the outside wet-bulb temperature is at any point below the well water temperature the use of the first dehumidifer is discontinued, and all air taken from outside so long as the external wet-bulb does not fall below the dew-point temperature desired in the shaping room. The use of refrigeration is still required under these conditions.

When the outside wet-bulb falls below the dew-point temperature desired in the shaping room, the second dehumidifier continues in service but the use of refrigeration is discontinued and the thermostat at the dehumidifier outlet, through valves and cross-connections in the air lines provided for the purpose, ceases to regulate the water volumes drawn by the pump from the upper and lower dehumidifier tanks, but is made to regulate interacting dampers in the fresh air intake and recirculating air duct, and the dehumidifier really becomes a humidifier, the water from upper tank being recirculated. By this arrangement the heat in the recirculated air is utilized in humidifying the fresh air taken in, consequently as it becomes increasingly colder outside, the amount of air recirculated automatically increases and the fresh air diminishes. This results in considerable economy of steam and at the same time makes unnecessary the use of a tempering coil.

The complete equipment was designed and furnished by Warren Webster & Company, Camden, N. J., and has been in operation for nearly two years, during which time it has given results which have vindicated the farsightedness of Mr. J. F Blandy, treasurer and general manager of the General Gas Mantle Co., through whose efforts the realization of the system was brought about. The difficulties previously experienced have completely disappeared and working conditions brought to a place of which any industry could be proud.

New Psychrometric Tables and Chart

In order to determine the amount of water vapor associated with air occupying a known volume, we must determine the saturation temperature and, from ordinary vapor tables (steam tables), obtain the vapor pressure.

The saturation point may be determined by reducing the temperature of a polished vessel and observing when moisture first forms on the surface. This temperature is commonly called "dew point." But such determinations require an experienced laboratory observer and cannot be conducted in the field.

It is for this reason, states a new handbook on "Psychrometric Tables for Cooling Tower Work," published by the Wheeler Condenser & Engineering Co., of Cartaret, N. J., that an indirect method of obtaining the dew point is used, namely, from suitable tables and from readings of the dry and wet bulb thermometers of a psychrometer,* which consists of two thermometers, suitably mounted, the bulb of one thermometer being covered by a close-fitting piece of muslin, which is well moistened in pure water, hence the term "wet bulb." There are two kinds of psychrometers, the stationary and sling. In the stationary psychrometer the two thermometers are suitably mounted and hung in a convenient place in the shade, and in a sling psychrometer they are whirled at a rate of about 200 R. P. M. by the observer. The sling psychrometer is the more accurate and these *tables are for use with sling psychrometer readings only.*

The wet bulb temperature must not be confused with the dew point, continues the handbook; it is from 0° to 20° higher. The dew point is the saturation temperature corresponding to the pressure of the vapor, while the wet bulb temperature is the temperature to which the evaporation of water from a wet cloth cools the mercury bulb of a thermometer when slung through the air. What happens is a heat interchange; the wet bulb temperature first dropping and then becoming finally fixed when the rate of heat absorption by convection from the air through which it passes equals the rate of cooling due to the evaporation of the moisture.

Simultaneous observations of dew point and wet and dry bulb thermometer readings have formed the basis for formulas and tables connecting the three temperatures.

The Weather Bureau of the United States Department of Agriculture has published authentic tables of this character by Prof. C. F. Marvin, based on the formula of Prof. Ferrel. A rational psychrometrical formula, connecting dew point and dry and wet bulb temperature readings, has also been the subject of investigation for many years, and recently

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*Instruments of this kind may be obtained from thermometer and instrument manufacturers.

TYPICAL SECTION OF TABLE 1.

Reading of Thermometer Deg. F.		Dew Point	Humidity	Vapor in 1000 Cu. Ft. of Mixture	Reading of Thermometer Deg. F.		Dew Point	Humidity	Vapor in 1000 Cu. Ft. of Mixture
Dry	Wet	Deg. F.	%	Lbs.	Dry	Wet	Deg. F.	%	Lbs.
32	32	32	100	.304	36	35	33.7	91	.321
	31.5	30.7	95	.289		34	31.2	82	.289
	31	29.5	89	.271		33	28.6	73	.258
	30.5	28	84	.256		32	25.3	64	.226
	30	26.7	80	.243		31	21.8	55	.194
	29.5	25	74	.225					
	29	23.5	69	.210	37	37	37	100	.367
	28.5	21.7	65	.198		36	34.8	91	.334
	28	20	61	.186		35	32.4	82	.300
						34	29.8	75	.275
33	33	33	100	.316		33	26.9	66	.243
	32.5	31.8	95	.300		32	23.5	57	.209
	32	30.4	90	.284					
	31.5	29	84	.265	38	38	38	100	.381
	31	27.6	79	.250		37	35.8	92	.351
	30.5	26.2	75	.237		36	33.4	83	.316
	30	24.7	70	.221		35	30.8	74	.282
	29.5	22.8	65	.205		34	28.0	66	.251
	29	21.2	61	.193		33	25.0	59	.225
						32	21.3	50	.190
34	34.	34	100	.328					
	33.5	32.8	95	.312	39	39	39	100	.395
	33	31.6	90	.295		38	36.8	92	.364
	32.5	30.2	85	.279		37	34.4	84	.332
	32	28.7	80	.262		36	31.9	75	.296
	31.5	27.3	75	.246		35	29.2	67	.265
	31	25.7	70	.230		34	26.3	59	.233
	30.5	24.2	66	.216		33	23	52	.205
	30	22.5	61	.200					
	29.5	20.5	57	.187	40	40	40	100	.410
						39	37.8	92	.377
35	35	35	100	.340		38	35.6	84	.344
	34	32.7	90	.306		37	33	75	.308
	33	30.4	82	.279		36	30.5	68	.279
	32	27	71	.241		35	27.5	00	.246
	31	23.3	65	.225		34	24.4	53	.217
	30.	20.6	55	.187		33	20.3	46	.180
36	36	36	100	.353	41	41	41	100	.425

an accurate formula has been deduced by W. H. Carrier, Transactions A. S. M. E., 1911 (published in THE HEATING AND VENTILATING MAGAZINE for March, 1912).

Once the dew point is known, the vapor pressure, the weight of moisture in a cubic foot, the relative humidity and the weight of the air in a cubic foot, etc., may all be obtained from steam tables and the fundamental law of gases.

The numerous tables, similar to those shown herewith, giving the dry and wet bulb temperatures, dew point, per cent., humidity and pounds of moisture per 1,000 cu. ft., were read from a large alignment chart prepared especially for the Wheeler Condenser & Engineering Company, by Prof. H. L. Parr, of Columbia University. The tables of properties of water vapor, by Marks and Davis, were used to obtain the vapor densities at different pressures. Acknowledgement is made to Mr. A. Gelhausen, of the Wheeler Company, for his painstaking care in tabulating the figures.

Prof. Parr's alignment chart is reproduced in Fig. 1 and gives the relation between dry bulb, wet bulb, dew point and per cent. humidity, any two being obtained from the other two. Readings can be made to within a small fraction of a degree. This chart agrees to within a very close percentage with the empirical formula, on which the U. S. Weather Bureau tables are based, and also very closely to the rational formula already referred to.

RANGE OF TABLES.

The range of dry bulb temperatures is from 32° to 140° F., and of wet bulb temperature, 28° to 140° F.

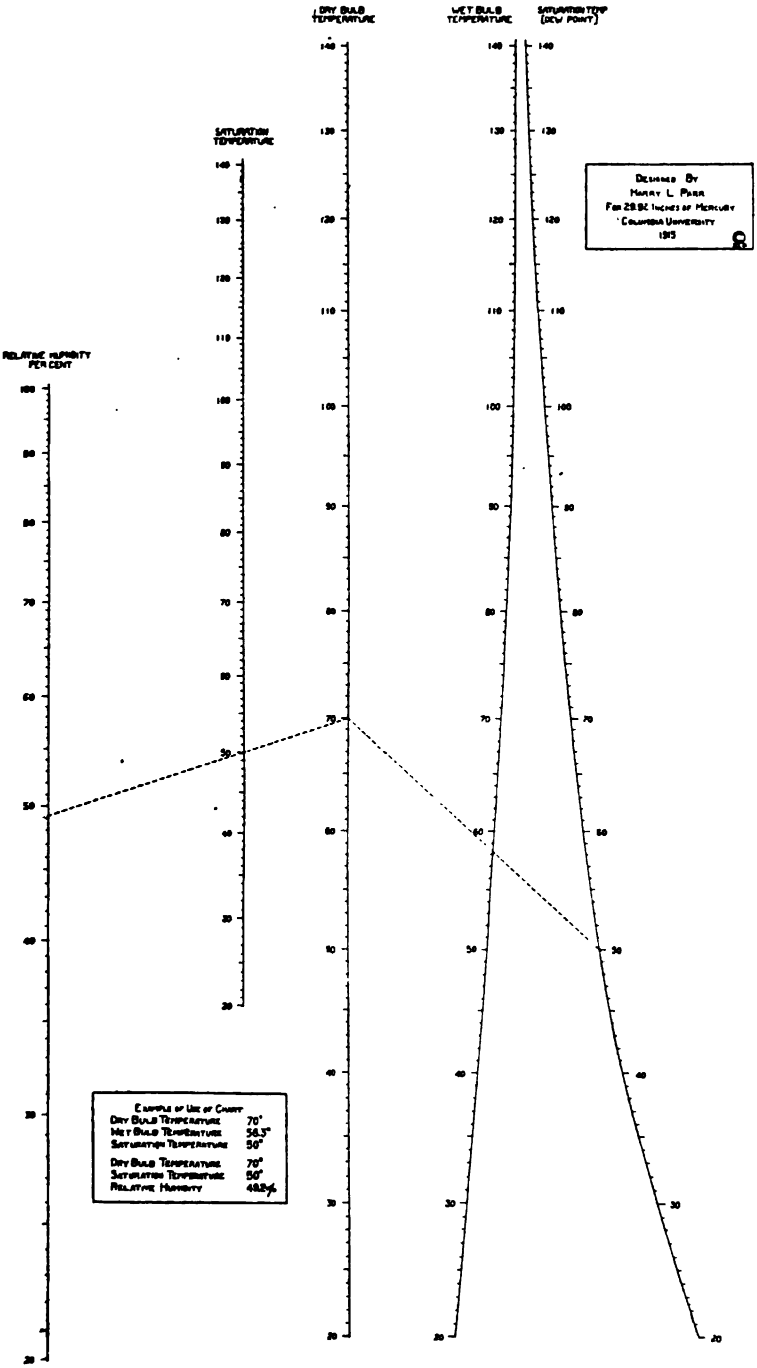
When the wet bulb temperature and dew point are below 32°, it is necessary for accuracy to know whether the vapor in the air was formed over ice, or "undercooled" water, since for the same temper-

TYPICAL SECTION OF TABLE 2.

Relation of Dew Point and Weight of Moisture per 100 Lbs. of Air. Barometer, 29.92 ins.

Dew Point Deg. F.	Lbs. Vapor Per 100 Lbs. Air Saturated	Dew Point Deg. F.	Lbs. Vapor Per 100 Lbs. Air Saturated	Dew Point Deg. F.	Lbs. Vapor Per 100 Lbs. Air Saturated	Dew Point Deg. F.	Lbs. Vapor Per 100 Lbs. Air Saturated
140	15.3038	110	5.9163	80	2.2102	50	.7623
139	14.8293	109	5.7308	79	2.1378	49	.7361
138	14.3615	108	5.5610	78	2.0670	48	.7088
137	13.9005	107	5.3785	77	2.0000	47	.6826
136	13.4703	106	5.2090	76	1.9329	46	.6565
135	13.0515	105	5.0455	75	1.8674	45	.6319
134	12.6327	104	4.8866	74	1.8041	44	.6086
133	12.2425	103	4.7329	73	1.7424	43	.5854
132	11.8575	102	4.5823	72	1.6836	42	.5633
131	11.4997	101	4.4369	71	1.6264	41	.5407
130	11.1457	100	4.2960	70	1.5706	40	.5204
129	10.7909	99	4.1597	6a	1.5171	39	.5008
128	10.4557	98	4.0271	68	1.4651	38	.4814
127	10.1310	97	3.8990	67	1.4154	37	.4626
126	9.8161	96	3.7732	66	1.3657	36	.4439
125	9.5103	95	3.6519	65	1.3160	35	.4263
124	9.2135	94	3.5344	64	1.2733	34	.4090
123	8.9280	93	3,4207	63	1.2286	33	.3947
122	8.6515	92	3.3084	62	1.1849	32	.3783
121	8.3834	91	3.2015	61	1.1435	31	.3632
120	8.1235	90	3.0975	60	1.1023	30	.3434
119	7.8711	89	2.9958	59	1.0644	29	.3280
118	7.6263	88	2.8979	58	1.0267	28	.3124
117	7.3863	87	2.8015	57	.9898	27	.2962
116	7.1578	86	2.7096	56	.9544	.26	.2962
115	6.9348	85	2.6192	55	.9205	25	.2723
114	6.7186	84	2.5323	54	.8886	24	.2594
113	6.5099	83	2.4482	53	.8542	23	.2476
112	6.3050	82	2.3653	52	.8226	22	.2358
111	6.1092	81	2.2862	51	.7917	21	.2249

PSYCHROMETRIC CHART



DESIGNED BY
HARRY L. PARR
FOR 29.92 INCHES OF MERCURY
COLUMBIA UNIVERSITY
1915

EXAMPLE OF USE OF CHART

DRY BULB TEMPERATURE	70°
WET BULB TEMPERATURE	58.5°
SATURATION TEMPERATURE	50°
DRY BULB TEMPERATURE	70°
SATURATION TEMPERATURE	50°
RELATIVE HUMIDITY	49.2%

SATURATION TEMPERATURE DEGREES F	VAPOR PRESSURE INS MERCURY	LBS VAPOR PER CU FT SATURATED	CUBIC FEET PER LB VAPOR SATURATED	LBS VAPOR PER LB AIR SATURATED
140	5.88	0.00814	122.8	0.153038
139	5.73	0.00795	125.8	[illegible]
138	5.58	0.00776	128.8	0.143613
137	5.43	0.00757	132.1	0.139005
136	5.28	[illegible]	135.4	0.134795
135	5.16	0.00721	138.7	0.130515
134	5.02	0.00703	142.2	0.126327
133	4.89	0.00686	145.8	0.122425
132	4.76	[illegible]	149.4	0.118575
131	4.64	0.00653	153.2	0.114887
130	4.52	0.00637	157.1	0.111457
129	4.399	0.006207	161.1	0.107909
128	4.282	0.006052	165.3	0.104557
127	4.168	0.005900	[illegible]	0.101310
126	4.057	0.005751	173.9	[illegible]
125	3.948	[illegible]	178.4	[illegible]
124	3.841	0.005462	183.1	0.092135
123	3.737	[illegible]	187.9	[illegible]
122	3.635	0.005187	192.8	[illegible]
121	3.535	0.005054	197.9	[illegible]
120	3.438	0.004924	203.1	[illegible]
119	3.344	0.004796	208.5	0.078711
118	3.252	0.004671	214.1	0.076263
117	3.161	0.004548	219.9	0.073868
116	3.073	0.004429	225.8	0.071578
115	2.987	0.004312	231.9	[illegible]
114	2.904	0.004198	238.2	0.067186
113	[illegible]	0.004087	244.7	[illegible]
112	2.740	0.003978	251.4	[illegible]
111	2.665	0.003871	258.3	[illegible]
110	2.589	[illegible]	265.5	[illegible]
109	2.515	0.003664	272.9	[illegible]
108	2.443	0.003565	280.5	[illegible]
107	2.372	[illegible]	288.3	0.053785
106	2.303	0.003374	296.4	0.052090
105	2.236	0.003282	304.7	[illegible]
104	2.171	0.003192	313.3	[illegible]
103	2.107	0.003104	322.2	[illegible]
102	2.045	0.003017	331.5	[illegible]
101	1.985	0.002933	341.0	[illegible]
100	1.926	0.002851	350.8	[illegible]
99	1.869	0.002771	360.9	[illegible]
98	1.813	0.002693	371.4	[illegible]
97	1.759	0.002617	382.2	[illegible]
96	1.706	0.002542	393.4	[illegible]
95	1.655	0.002469	405.0	[illegible]
94	1.605	0.002398	417.0	[illegible]
93	1.556	0.002329	429.4	[illegible]
92	1.508	0.002261	442.2	[illegible]
91	1.462	0.002195	455.5	[illegible]
90	1.417	0.002131	469.3	[illegible]
89	1.373	[illegible]	483.5	[illegible]
88	1.331	[illegible]	498.4	[illegible]
87	1.289	0.001947	513.7	[illegible]
86	1.248	[illegible]	529.5	[illegible]
85	1.209	0.001832	[illegible]	[illegible]
84	1.171	0.001777	562.9	[illegible]
83	1.134	0.001725	[illegible]	[illegible]
82	1.098	0.001670	[illegible]	[illegible]
81	1.063	0.001619	617.5	[illegible]
80	1.029	0.001570	637.	0.022102
79	0.996	0.001523	657.	0.021378
78	0.964	0.001477	677.	[illegible]
77	0.933	0.001433	698.	[illegible]
76	0.903	0.001389	720.	[illegible]
75	0.873	0.001346	743.	0.018674
74	0.845	0.001304	767.	0.018041
73	0.817	0.001263	792.	0.017424
72	0.790	0.001224	817.	0.016835
71	0.764	0.001186	843.	0.016264
70	0.739	0.001148	871.	0.015706
69	0.714	0.001112	[illegible]	0.015171
68	0.690	0.001077	928.	0.014681
67	0.667	0.001043	955.	0.014194
66	0.644	0.001009	991.	0.013657
65	0.622	0.000977	1024.	0.013160
64	0.601	[illegible]	1058.	0.012738
63	0.580	0.000915	1093.	0.012206
62	0.560	[illegible]	1130.	0.011849
61	0.541	[illegible]	1168.	0.011435
60	0.522	[illegible]	1208.	0.011029
59	0.5034	0.000801	1249.	0.010644
58	0.4856	0.000775	1291.	0.010267
57	0.4684	0.000749	1335.	[illegible]
56	0.4518	0.000724	1381.	0.009544
55	0.4357	0.000700	1430.	[illegible]
54	0.4201	0.000676	1480.	[illegible]
53	0.4049	[illegible]	1532.	[illegible]
52	0.3903	[illegible]	1585.	[illegible]
51	0.3762	[illegible]	1643.	0.007917
50	0.3625	[illegible]	1702.	[illegible]
49	0.3492	[illegible]	1763.	0.007351
48	0.3363	[illegible]	1826.	[illegible]
47	0.3238	0.000529	1892.	[illegible]
46	0.3118	0.000510	1961.	[illegible]
45	0.3002	[illegible]	2033.	[illegible]
44	0.2890	0.000475	2107.	[illegible]
43	0.2782	[illegible]	2183.	[illegible]
42	0.2677	0.000441	2266.	[illegible]
41	0.2575	0.000425	[illegible]	[illegible]
40	0.2477	0.000410	[illegible]	[illegible]
39	0.2382	0.000395	2530.	[illegible]
38	0.2290	0.000381	2626.	[illegible]
37	0.2202	0.000367	2725.	[illegible]
36	0.2117	0.000353	2829.	[illegible]
35	0.2034	0.000340	2938.	[illegible]
34	0.1953	0.000328	3052.	[illegible]
33	0.1878	0.000316	3170.	[illegible]
32	0.1804	0.000304	3294.	[illegible]
31	0.1720	0.000289	3460.	0.003592
30	0.1643	0.000276	3623.	0.003424
29	0.1565	0.0003265	3774.	0.003280
28	0.1495	0.000253	3953.	0.003124
27	0.1426	0.000242	4132.	0.002982
26	0.1362	0.000232	4310.	[illegible]
25	0.1298	0.000222	4504.	0.002725
24	0.1239	0.000212	4717.	0.002594
23	0.1182	0.000203	4926.	0.002478
22	0.1127	0.000194	5135.	0.002358
21	0.1076	0.000185	5405.	0.002248
20	0.1026	0.000176	5683.	0.002134

NEW PSYCHROMETRIC CHART, WITH TABLE, FOR QUICK FIGURING.
(Designed by Harry L. Parr, Columbia University, New York.)

ature the former vapor has a lower pressure. These tables refer to water vapor throughout, including the lines with dew points below 32°, where the maximum difference is one degree, as compared to vapor office. At lower dew points the difference would be greater. For very low temperatures the reader is referred to the United States Weather Bureau tables based on careful experiments of vapor pressure over ice.

In making winter observations with the sling psychrometer, it is pointed out that care must be taken that the wet bulb, if still moist, does not suddenly freeze and liberate heat. If it does, the whirling must be repeated until a ***minimum stable*** temperature is reached.

HUMIDITY.

The absolute humidity, of course, is the amount of moisture, often expressed in grains, in a cubic foot of space, also occupied by air. In these tables the moisture is given in pounds per 1,000 cu. ft. as a more practical engineering unit. The relative humidity is here expressed as the ratio of the absolute humidity to the absolute humidity if the water vapor were saturated at the observed dry bulb temperature. Thus the air temperature might be 79° F. and the dew point, 65° F. The pressure corresponding to 65° is 0.622 in. and the pounds per 1,000 cu. ft. (see Marks and Davis steam tables) is 0.977. As the superheat is 14°, the volume is increased so that the pounds per 1,000 cu. ft. at 79° =

$$0.977 \times \frac{460+65}{460+79} = 0.950.$$

If saturated at 70° F. the vapor pressure would be 0.996 in. and the density 1.523. The ratio 0.950 ÷ 1.523 =62.5% is the relative humidity.

WEIGHT OF 1,000 CU. FT. OF AIR.

An approximate basis for calculations involving the movement of air is 13 cu. ft. per pound.

To be accurate we must take into account the temperature of the air, and the partial pressure of the air which depends on the barometric pressure and the partial vapor pressure.

Vapor pressures are not given in these tables, but may be readily obtained by looking up the pressures corresponding to the dew point in a book of steam tables.

A convenient formula for the weight of 1,000 cubic feet of air is

$$W = 1330 \frac{B-V}{T}$$

Where W = weight of 1,000 cu. ft.

B = barometric pressure in inches of mercury (mercury corrected to physical standard of 32°).

V = vapor pressure corresponding to dew point in inches of mercury.

T = Absolute temperature = 460 + Fahr.

This formula is based on the experimental determinations of Rayleigh and Leduc.

Example:

Barometric pressure 29.5 in.

Dew point from dry and wet bulb readings, 60° F.

Air temperature, 70° (dry bulb).

The vapor pressure corresponding to 60° is 0.522 in., therefore:

$$W = 1330 \times \frac{29.5-0.522}{530}$$

$$= 1330 \times \frac{28.978}{530}$$

$$= 72.6 \text{ lbs.}$$

WEIGHT OF 1,000 CU. FT. OF MIXTURE.

This is the sum of the weights of 1,000 cu. ft. of air and the vapor in 1,000 cu. ft. under the existing humidity.

For the foregoing conditions the tables give the pounds of moisture per 1,000 cu. ft. as 0.81 and the total weight is 0.81 + 72.6 = 73.41 lbs.

MOISTURE PER 100 LBS. OF AIR.

While the absolute humidity is always expressed in grains per cubic foot, or, as in these tables, pounds per 1,000 cu. ft., it may be expressed as the weight of moisture associated with a given ***weight of air,*** assuming a fixed barometric pressure. The assumed atmospheric pressure and the given conditions of temperature and dew point determine the volume occupied by the air, while the dew point determines the moisture in each cubic foot. Table II. gives the pounds of vapor associated with 100 lbs. of air saturated for dew points from 140° to 21°, and a barometric pressure of 29.92 in. of mercury.

The moisture per 100 lbs. of air is the same for the same dew point temperature and barometric pressure, irrespective of variation in dry and wet bulb thermometer readings. Thus, from Table I the dew point for 89° dry and 65° wet bulb is 50° and for 72° dry and 59° wet bulb it is also 50°, and the moisture per 100 lbs. of air from Table II for 29.92 barometer is the same in both cases and equal to 0.7623 lbs.

Humidity and Automatic Control

With Comparisons of Different Arrangements of Heaters and Reheaters and Their Effects.

BY HAROLD L. ALT

The modern air washer has introduced a new element in the hot blast heating and ventilating system which requires, not only that automatic control must be thoroughly understood, but that the requirements of the air washer must also be realized and properly met. As the air washer will vary, the humidity attained by the air in its final condition in the room, a thorough knowledge of the basic principles of humidity is necessary and, since the humidity is controlled by the temperature of the washing water, it is necessary to again revert to automatic temperature control in the washer to properly humidify the air.

BASIC DATA ON HUMIDITY.

It is a fairly well known fact that air at zero—which is the usual starting point for most heating and ventilating calculations—contains very little moisture, this amount being a maximum of roughly 1/14000 lb. of water per cubic foot. With this amount of moisture vaporized per cubic foot the air is saturated and will begin to precipitate the moisture, if the temperature is lowered or increased.

The vapor carrying capacity is greatly increased with a rise in temperature, so that a cubic foot of air at 32°, or freezing point, will carry 2/7000 lb. of water before it will start to precipitate. This is illustrated graphically in Figs. 1 and 2, Fig. 1 showing the quantity of water (black) in a cubic foot of air when compared to the amount (Fig. 2) contained at 32°.

A further increase in temperature continues the process, so that at 70° the amount of water per cubic foot can be raised as high as 8/7000 lbs. and at 100° it reaches about 19/7000, these increases being shown graphically (in black) in Figs. 3 and 4.

Normally, outside air varies in humidity within certain limits, usually between 35% and 75% of its total carrying capacity at the temperature of the air in question. A humidity of over 75% produces an excessively close feeling, which is very uncomfortable, and a humidity of less than 35% results in an atmosphere which is entirely too dry.

The average humidity is usually assumed at about 50% or 60% and is commonly termed "relative" humidity, it being a percentage relative to the total vapor carrying capacity of the air at the temperature in question, the total capacity being reached at the dew point, termed "absolute" humidity, and expressed in grains per cubic foot. Therefore, every temperature between zero and 100° F. has an *absolute* humidity graduated between ½ and 19 grains, the limits shown in Figs. 1 to 4, and the relative humidity

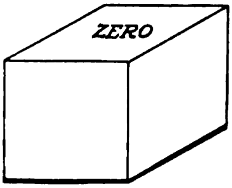


FIG. 1.

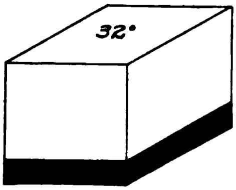


FIG. 2.

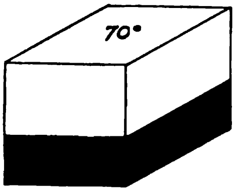


FIG. 3.

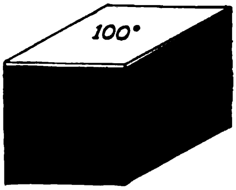


FIG. 4.

also graduates as it is a purely mathematical percentage of the absolute humidity.

The amount of moisture in air is usually computed in grains of water per cubic foot of air and is much easier to calculate in this way. There being 7,000 grains in a pound, the absolute humidity of air at 0° equals about ½ grain;

At 32° equals about 2 grains;
At 70° equals about 8 grains;
At 100° equals about 19 grains.

HOW TO OBTAIN ANY DESIRED PERCENTAGE OF HUMIDITY.

It can be readily understood from this short discussion of humidity that it is possible to obtain any desired percentage of humidity in air at 70° by saturating the air at a temperature where the total quantity of water just equals the total quantity required at the desired percentage when raised to 70°.

For example: Suppose it were desired to have 70° air with 25% relative humidity.

Absolute humidity at 70° dew point equals 8 grains.

25% of this equals 2 grains.

Now as 2 grains is just the amount of moisture in the air when *saturated* at 32°, if the air is saturated at 32° by means of an air washer spray it will contain 2 grains of water per cubic foot, and, when heated up to 70° by a heater, will have the desired 25% relative humidity.

It has been found by experience that about 60% relative humidity is the most satisfactory percentage for indoor work, which at 70° room temperature means 8×0.60, or 4.8 grains per cubic foot. As 4.8 grains per cubic foot is the same amount of water as will give saturated air at about 55°, this at once determines the temperature at which the air must leave the air washer.

Where humidity considerations enter the field, the problem resolves itself into raising the air from the outside temperature (usually zero) at the intake to about 55° where it leaves the air washer, and then the raising to the desired temperature for heating (usually 120°) or for ventilating only (usually 70°).

RELATIVE HUMIDITY MUST BE BASED ON FINAL ROOM TEMPERATURE.

Regardless of the transmitting temperature (whether 70°, 120° or any point between the two), the relative humidity must be based on the room temperature (usually 70°) as the air falls back to the room temperature after entering the room.

In spite of the fact that some manufacturers claim that tempering heaters are not necessary between the intake and the air washer, it is not the common practice to so install this apparatus, and, for the purposes of this article, it is necessary that the most common and accepted arrangements be considered in order to make the application of the diagrams as general as possible.

THREE METHODS OF CONTROLLING STACKS OF TEMPERING HEATER.

Probably the most common arrangement of heaters and washer is shown in Fig. 5, where a tempering heater of two rows is placed before the washer and a re-heater of two rows follows: The fan may be assumed as being interposed either between the air washer and the first row of the re-heater (Space D), or between the first and second row of the re-heater (Space E). The position of the fan has little effect on the method of controlling the tempering heater, but may affect the re-heater control to some extent.

It is generally agreed that the most ideal form of temperature control is that which results in the minimum amount of opening and closing of the valves in the pipes to the heater, at the same time maintaining fairly constant temperature at some given point beyond the heater. With this in mind the three methods of controlling the stacks of the tempering heater (shown in Figs. 5, 6 and 7) can be readily compared.

It is assumed in these three diagrams that the velocity of the air through the tempering heater and the surface therein is just sufficient to raise the air 20° in passing through each row. While this 20° rise would fall off slightly as the outside temperature increases, this is neglected in all three cases, as it has no practical bearing on the points desired to bring out.

DESCRIPTION OF FIRST METHOD OF CONTROL.

The inclined lines shown on Fig. 5 indicate by their rise or fall the changes of the air temperature during the progress through the apparatus, starting at various outside temperatures from zero to 60°. The location of the control thermostats is shown by T enclosed within a circle and the height of the T vertically indicates the temperature at which the heater closes off.

From this it can be seen that in Fig. 5 the first stack is controlled by a thermostat located between the second heater and the air washer (in Space C) and set for about 40°. The second row is controlled by another thermostat similarly located and set for 42°. This would seem to be an ideal control, as the temperature of the air entering the air washer is held between 40° and 42° all the time until the outside temperature rises above that figure.

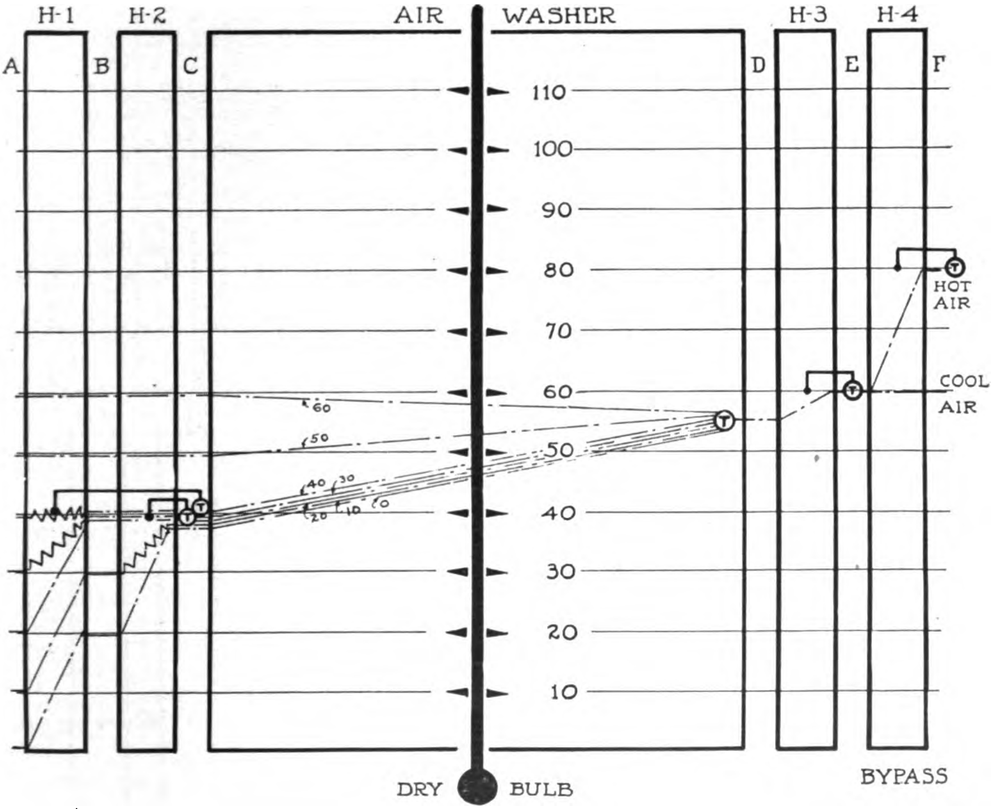


FIG. 5.—FIRST METHOD OF CONTROLLING STACKS OF TEMPERING HEATER.

A great mistake is often made in ventilation systems by basing their design solely for zero conditions, without a thought as to average winter weather, which runs from 20° to 40° outside temperature. If the temperature line for air entering at zero is followed across the first stack it is found that the air is raised to 20° F. The line then crosses horizontally to the second row, where it again rises 20°, or to 40°—right on the boundary where the second stack will begin to oscillate between the "off and on"—"off and on," condition.

Any increase above zero will result in a sufficient rise of the air temperature to immediately start the stack fluctuating, this continuing until an outside temperature of about 21° is reached, producing 41° at the thermostats, at which time the second row will go off completely and the increase of a single degree will start the first row oscillating.

This is graphically shown by the temperature line for air entering at 10°, rising to 30°, then rising in a zig-zag line across the second row, where it is increased only to 40°, on account of the retarding effect of the thermostat on the second row; the zig-zag indicates that the temperature rise is not the full capacity of the heater and the heater, therefore must be fluctuating.

Air entering at 20° rises to 40° in passing through the first stack and thereby shuts off the second. Air entering at 30° zig-zags across the first row, reaching 42°, and then passes through the second row without any farther change. Air at 42° shuts off all tempering heat and enters the air washer unchanged. Air at 50° is raised in passing through the air washer to 55°, but 60° air is cooled by evaporation to 55°.

The effect of such control can be summarized briefly by

(a) Variation of air temperature entering air washer 60° maximum, 40° minimum or 20 *degrees.*

(b) Oscillation of one heater or the other from zero temperature to 42° maximum or 42° *minimum range.*

SECOND METHOD OF CONTROL.

Compare this with the control shown in Fig. 6, where the first tempering coil is controlled by a thermostat in the cold air intake (Space A), set for 35°, and the second row is controlled by another thermostat set for 55°, and located between the tempering heaters and the air washer (Space C).

Zero air then rises to 20° in the first row, to 40° in the second, and to 55° in the air washer. No fluctuation is experienced at this temperature, nor indeed at 10° entering temperature and it is not until 15° air is reached that fluctuation of the second row is encountered. This continues until 35° outside air is reached, at which time the outside stack goes off and the second row continues to wobble until 55° is reached when the second row also goes off entirely.

Conditions for this method of control show:

(a) Variation of air temperature entering air washer 60° maximum, 40° minimum or 20°.

(b) Oscillation of one heater from 15° to 55° or 40° *total range.*

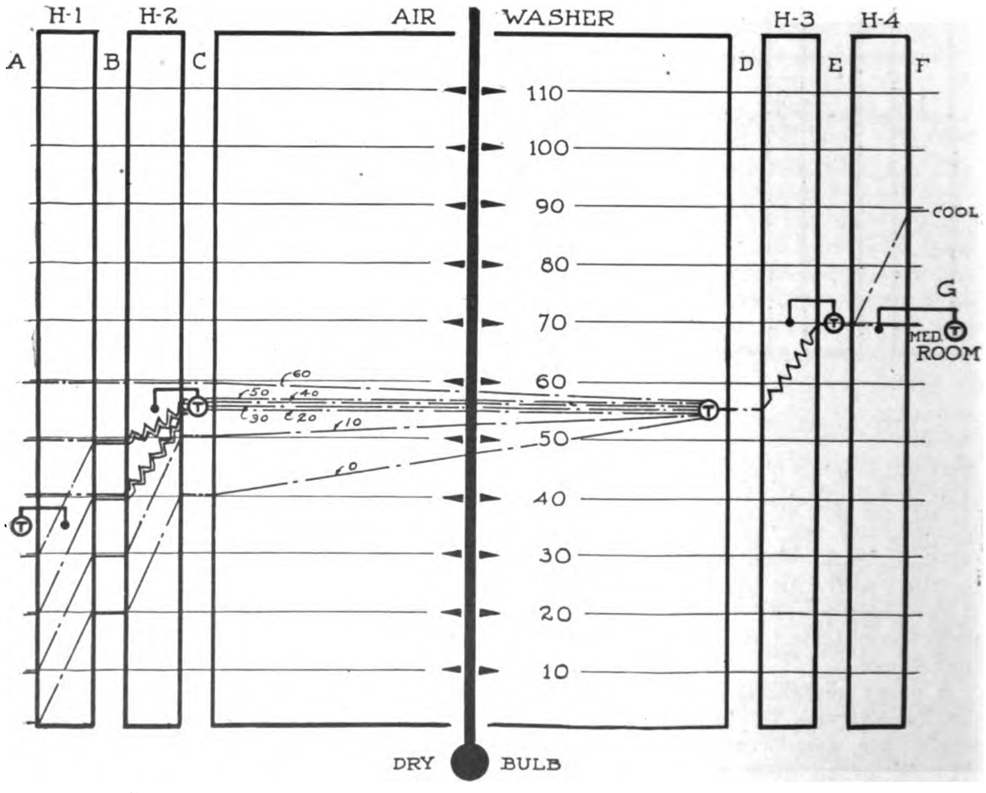


FIG. 6.—SECOND METHOD OF CONTROLLING STACKS OF TEMPERING HEATER.

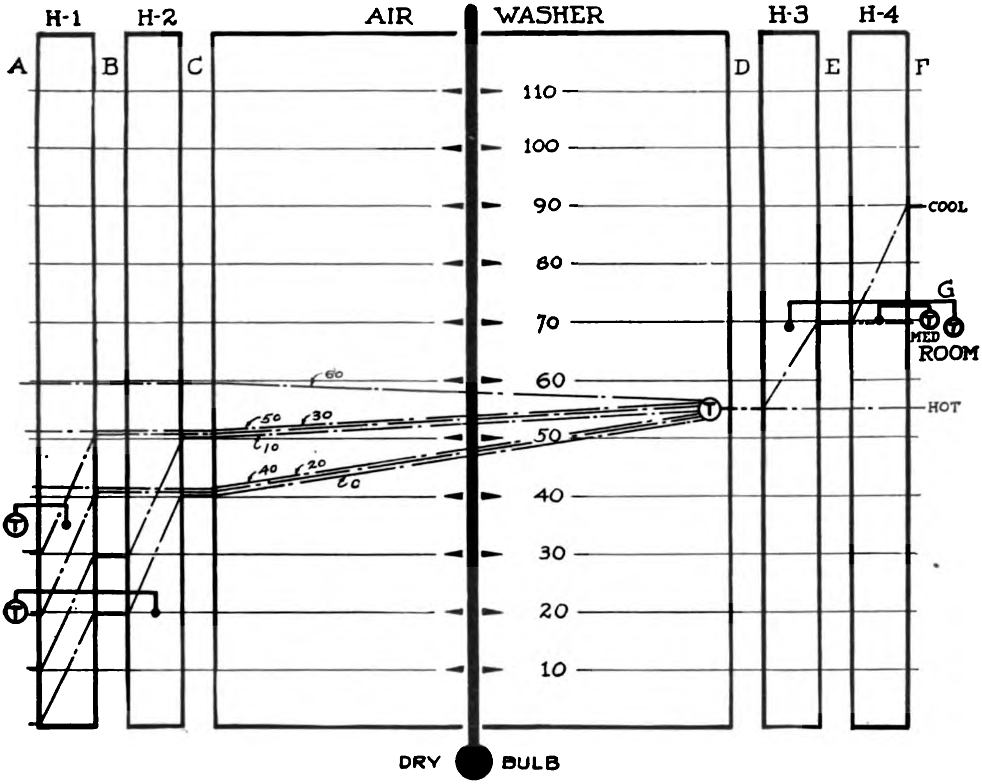


FIG. 7.—THIRD METHOD OF CONTROLLING STACKS OF TEMPERING HEATER.

This shows little improvement in any way over Fig. 5.

THIRD METHOD OF CONTROL.

In Fig. 7 the tempering heater has both stacks controlled from thermostats located in the cold air intake (Space A), one thermostat on the first row being set to throw on the stack at 35° or below and the other thermostat being set to throw on the second row at 20° or below.

Following the temperature lines of air entering at zero, it is seen that it rises to 20° in the first row and to 40° in the second, being raised from 40° to 55° by the air washer. At 10° above the air is heated to 50° by the heaters and the remaining 5° in the air washer.

At 19° above the air is raised to 59° and then cooled in the air washer to 55°, but at 20° the second row shuts off and the air enters the air washer at 40°. At 30° the second row is off and the air is raised to 50° by the first row, the remaining 5° being cared for in the washer. At 40° the tempering heater has been closed off entirely (this occurring at 35°), and the air enters the washer at 40°, being raised 15° more in the washer.

The net results of this arrangement are as follows:

(a) Variation of air temperature entering air washer—maximum, 60°—minimum, 40° equals 20°.

(b) Fluctuation—*None.*

This shows that the control of all tempering stacks from the cold air chamber not only does away with their wobbling, but also does this at practically no increased variation in air temperature at the entrance to the washer over that encountered by other schemes of control.

TREATMENT OF THE AIR AS IT LEAVES THE AIR WASHER.

On the outlet end of the air washer, with a saturated temperature of 55°, a vastly different condition results; whereas before the air entered at widely varying temperatures all of which it was desired to raise to as nearly 55° as possible, it is now required to vary the air temperature constantly at 55° to another temperature suitable for the requirements in the room or rooms supplied by the system.

Suppose a double duct system is in use, or an individual duct system where air is taken from hot and cool air chambers so as to produce the desired duct temperature by means of automatic mixing dampers.

In order to make such a system a success thermostatic control of the mixing dampers from the room must be had. Also, if a room is overheated, it is not allowable to blow cold air at 55° into it—this air being, by the way, saturated as well. This condition is usually taken care of by automatic control of the mixing dampers, in the duct or at the base of the flue, by a thermostat located in the room.

In order to make sure that no air at 55° gets to the rooms it is customary to place the heater H3 (Fig. 5) next to the air washer and to insert the fan in space E, the discharge from the fan blowing both through and under the heater H4 by means of the bypass below into the cool air chamber.

Since the air in the cool air chamber should be 60° to avoid cold drafts in the room, and as this air bypasses H4, it follows that the heater H3 must raise the air from the final air washer temperature to 60°. In the case under consideration this means only a rise of 5°, involving a narrow heater and very high velocities In fact friction consideration alone would recommend decreasing the saturated temperature of the air washer to 50° and then raising the air 10° in heater H3 even at the sacrifice of a little humidity in the room later.

There seems to be no logical reason for automatic control on the heater H3, unless the system supplies air in varying quantities from time to time, as the quantity of air, velocity, entering temperature and desired rise are all constants for a given system. There is absolutely no reason why H3 cannot be designed for the 5° or, better, the 10° rise and then be allowed to run full open all the time, if the equipment is operated as intended.

COMPLICATIONS TO PROVIDE AGAINST.

Of course, stoppage of the air washer, or a change in air quantity would produce complications so that in general practice the thermostat is used set for 60° in the fan space E, while the heater H3 should be designed to raise the largest amount of air handled from the lowest temperature at which it enters the washer (40°) to the desired 60°. This will allow the discontinuation of humidifying, the closing down of the washer, or a change in air quantity, all without loss of the desired temperature; the heater, however, will wobble constantly, never being full on or off under normal conditions.

The quantity of air passing through the heater H4 is never constant and while the entire amount may go through on a cold morning when the building is just getting warmed up, along in the middle of the day it may all be bypassed. There seems to be no reason for trying to control the heater H4 automatically, as the temperature of air in the room outlets is controlled from a room thermostat operating the mixing dampers. Therefore, it is entirely practical to design the heater of a size sufficient to heat the total amount of air to the desired temperature (80° or 85° for ventilation or up to 120° or 140° for indirect heating), allowing this heater to remain on at all times. When the building has heated up and most of the air is being taken from the cool air bypass, the air in the hot air chamber will go way up in temperature possibly to 200° or so. To those who fear such a contingency a thermostat placed in the hot air chamber F and set at, say, 150°, would prevent such overheating without wobbling.

The usual practice, however, is to place a thermostat in the hot air chamber F, this being set at the desired air temperature so as to result in a constant and continued fluctuation of the heater H4. This is shown graphically in Fig. 5.

The second common arrangement of re-heaters is indicated in Fig. 6, where one large room is heated or ventilated and the temperature of all the air is controlled by controlling the re-heater. In this case the fan may be located either in the space D, or better, E, or the entire equipment may be placed on the suction side of the fan with the fan placed at F. If the fan is placed at D it will handle saturated air; if at F, the hottest air; while if located at E, it will handle air at medium temperature and considerable above the dew point.

If two thermostats are used in the warm air chamber F similar to the arrangement shown in Fig. 5, the same oscillation will result, but if one thermostat is located in the room G and one in the space E, with the heater H3 giving 15° rise, the result is 70° air at all times when the room is up to proper temperature and any drop in room temperature below 68° promptly throws on heater H4, so that air at 90° (H4 giving 20° rise) is furnished until the room is brought back to normal. Under this condition H3 will still fluctuate.

If both thermostats should be located in the room G, as shown in Fig. 7, one set at 70° and one, say, at 65°, there is little liability of trouble. Then heater H3 will be on constantly unless the room overheats, while heater H4 will cut in, giving 90° air only when the room goes below 65°. The change in the room will be much more gradual than in a hot air chamber, with a corresponding reduction in trouble. The objection may be urged that when the room is overheated saturated air will be introduced, owing to both heaters being shut off. It must be remembered however, that this danger is only present *when* the room is over 70°, in which case the entering air will immediately become mixed with the room air and its temperature raised so as to make condensation very unlikely.

Another solution would be to split the heater H3 into two rows, one giving 5° rise at all times and without automatic control, while the second could give the other 10° rise, controlled just the same as the heater H3 shown.

Saturation Curves for Vapor, and Weight of Air

By A. BEMENT.

The writer has found that difficulty is often experienced in determining the amount of moisture required for humidification, owing to the absence of simple data. Weight of vapor is usually given in grains, a measure not dealt with in any other connection by engineers, and which must be transposed to pounds.

Therefore the curve Fig. 1 has been found useful. It shows weight of vapor at saturation from zero to 100° F. The vertical divisions of the diagram represent fractions of a pound and the horizontal divisions give the temperature.

To illustrate the use of the diagrams let it be assumed that it is necessary to humidify a room measuring 20 x 30 ft., with a height to the ceiling of 12 ft. Thus 20 x 30 = 600 and 600 x 12 = 7,200 cu. ft. in the room. Referring to Fig. 2, and taking the desired room temperature as at 65° and following the horizontal line from that figure to the curve, then down from that point to the bottom of the diagram two divisions beyond the figure 0.0750; then by adding to it 0.00050, we have 0.0755 as the weight of a cubic foot of air.

It is not always necessary to add this small amount, as the nearest figure of 0.075 is accurate enough for usual purposes. Therefore, 7,200 cu. ft. x 0.075 = 540 lbs. of air in the room.

Referring to Fig. 1 it is found that the horizontal line at 65° intersects the saturation curve at 0.012 and 540 x 0.012 = 6.48 lbs. of moisture for full saturation, but as a 50% relative humidity may be desired, the moisture requirement is one half of that or, 3.24 lbs.

The air from out doors contains some moisture which would supply a part of the requirements. Assuming an outdoor temperature of 30° F., it is found from Fig. 1 that the weight of the vapor at saturation is about 0.00375, but as the average relative winter humidity is about 75% of saturation, this saturation figure is reduced by the difference and becomes 0.0028. Thus, 540 x 0.0028 = 1.5 lbs.

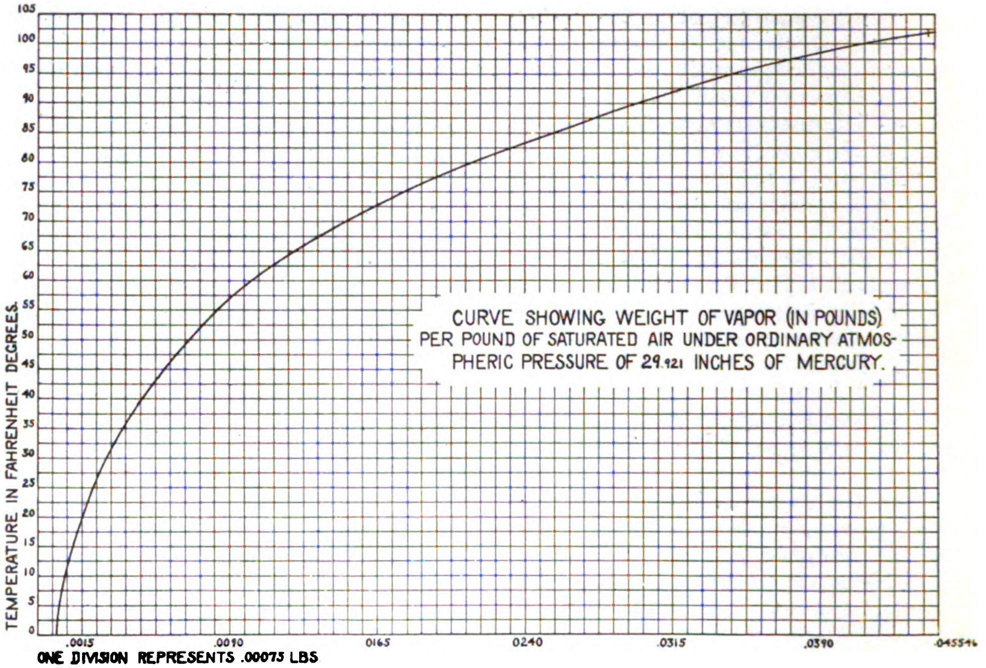


FIG. 1.

Therefore 3.24 — 1.5 = 1.74 lbs. of moisture to be supplied to cover the deficiency. This is the requirement for the air in the room, and is the amount that must be supplied per hour if the air is changed once per hour, but if changed oftener the required moisture will be in proportion to the number of changes.

It may be well to add to the foregoing that 1 lb. is equal to 7,000 grains.

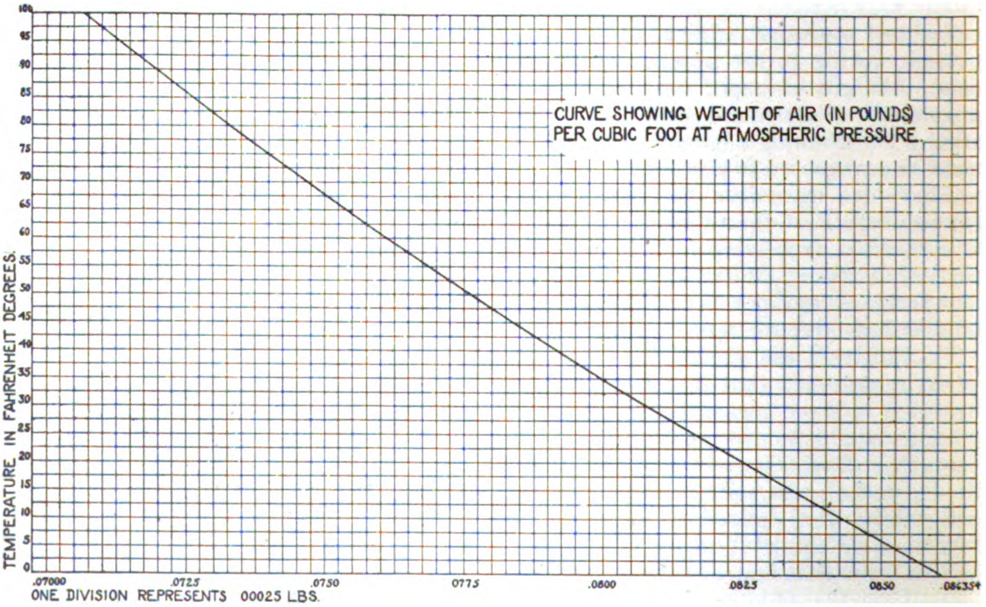
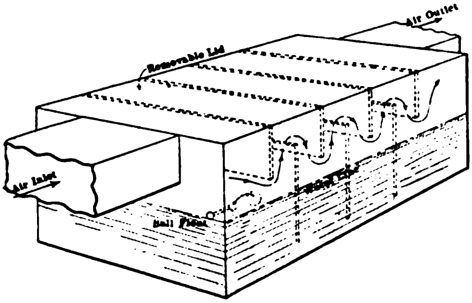


FIG. 2.

The Early History of Air Conditioning

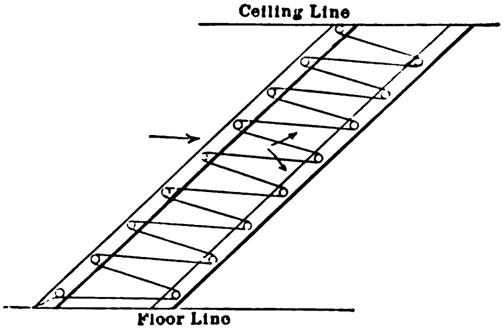
The accompanying illustrations are intended to present in graphic form the early development of air conditioning, or purification and cooling, apart from the process of heating the air.

Probably the earliest method of accomplishing this was through the use of cheesecloth screens. Then came the coke tower or coke washer, which consisted of a compartment filled with coke, over which water was run continuously. The air came in contact with this coke and a certain amount of the dirt was washed out. The objection to the coke tower was that it became foul and, unless cleaned frequently, objectionable odors emanated from it, indicating imperfect cleansing.

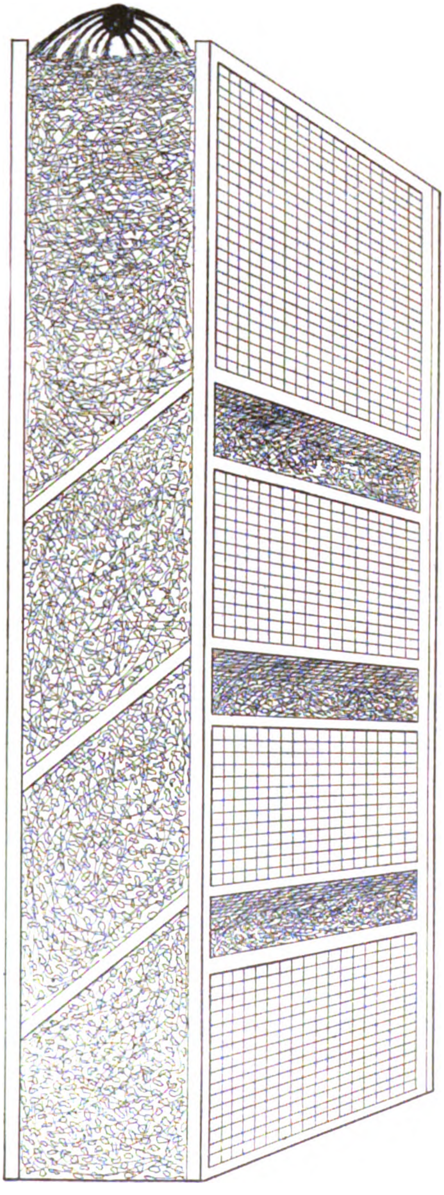


EARLY DEVICE FOR WASHING AIR.

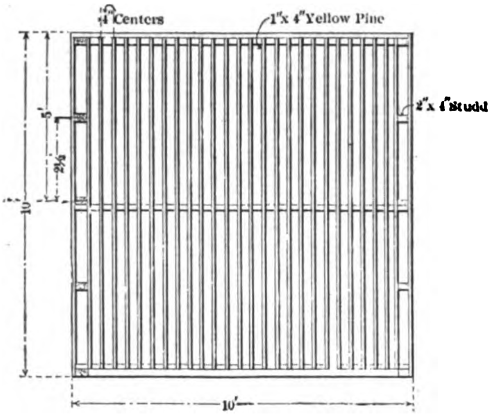
In the latter part of 1896, Joseph McCreery, who was then a prominent expert on ship ventilation, conceived the idea of passing water over a series of plates, so arranged that the air would be forced to make a tortuous passage and impinge against the wet surfaces of these plates. On July 13, 1897, he was granted a patent on his invention. This was the first all-metal wet air cleanser and was called an air washer. Undoubtedly this apparatus did not prove entirely satisfactory, because on June 6, 1899, Mr. McCreery was granted another patent covering an air washer that contained not only scrubbing



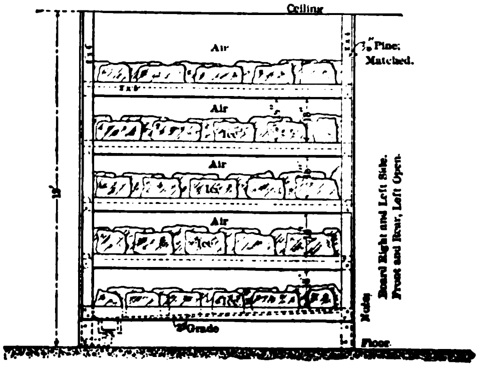
TYPE OF CHEESECLOTH FILTER FORMERLY USED IN BROOKLYN POST OFFICE.



COKE SCREEN USED FOR FILTERING AIR.

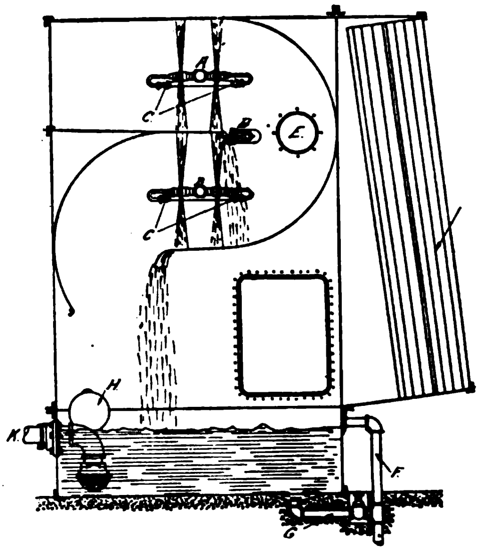


Plan



Front Elevation

USE OF ICE FOR COOLING AIR IN SCHOOL BUILDING.



McCREERY AIR WASHER, SHOWING USE OF PRESSURE SPRAY HEADS.

plates, but also spray nozzles. This was the first patent granted covering the use of sprays for cleansing air.

The various improvements made since that time and embodied in the various types now on the market, are of such recent development as to need no extended comment at this time. It is safe to say that the advances have been so rapid as to place American air conditioning practice in a class by itself

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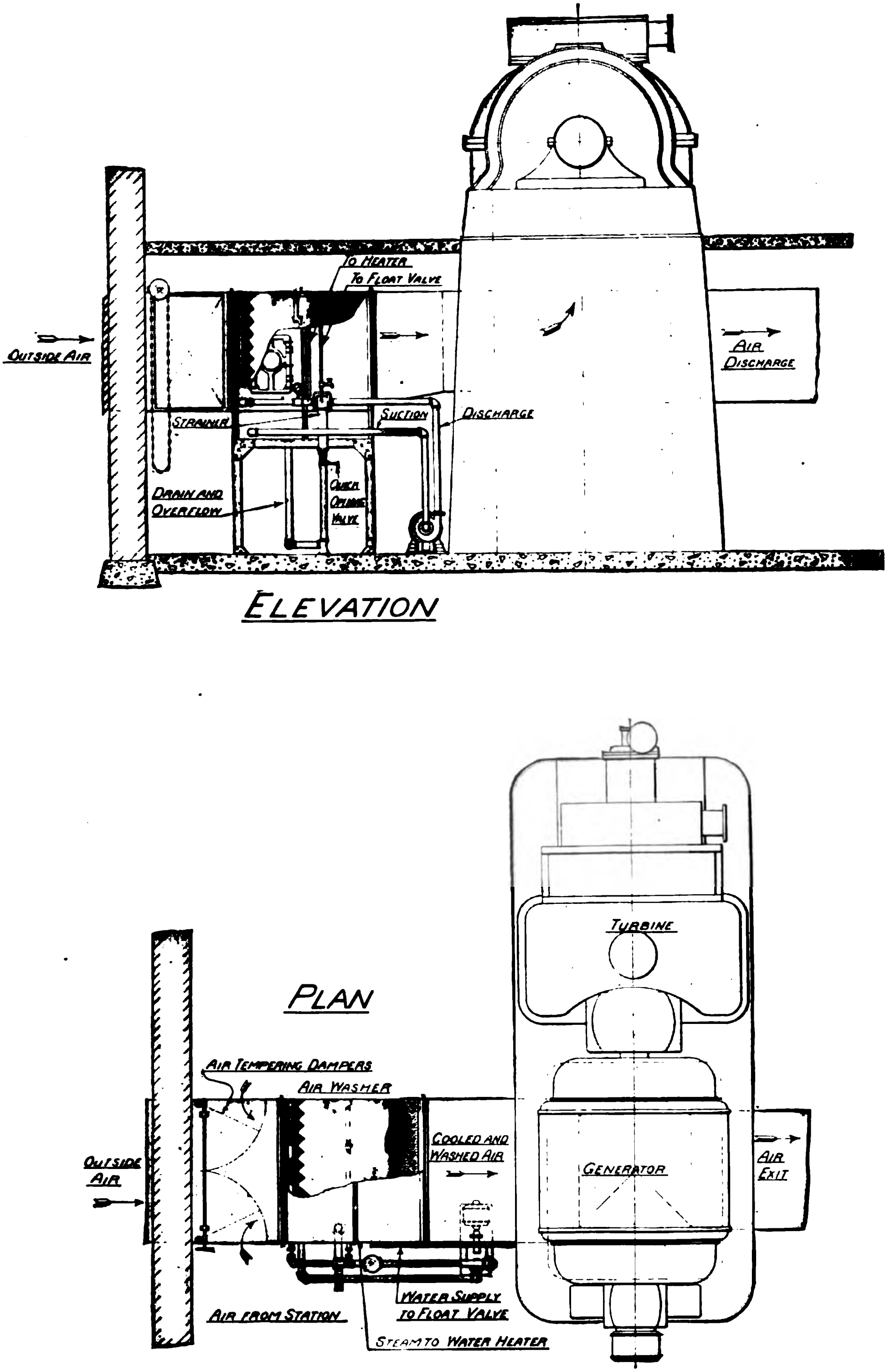
Washing and Cooling Air for Steam Turbine Generators

The proper ventilation of electric generators is a matter of great importance. All modern units are designed for a certain allowable maximum temperature in the armature and field windings. With a given load, the temperature of a generator will be a fixed amount above the temperature of the ingoing ventilating air; therefore, the cooler the air delivered to the generator, the greater will be its capacity.

Another equally important feature is that of the cleanliness of the ventilating air, and, unless proper equipment is provided to eliminate the dust or soot from the air, an accumulation of dirt is soon deposited within the machine, greatly reducing the cooling effect. Oily vapors that exist in air taken from the inside of power plants make such accumulations in the air passages particularly rapid. Dirty air, therefore, means excessive heat, which not only increases the ohmic resistance of the various windings, but shortens the life of the insulation, causing field-grounds and even burnouts unless the generator is taken apart and cleaned often. Therefore, the same consideration should be given to the quality as is given to the quantity and temperature of the ventilating air.

For this class of work a water-spray type of air washer and cooler is widely used, as well as air washers or humidi-



ELEVATION AND PLAN OF AIR-WASHER LAYOUT FOR TURBO-GENERATOR.

fiers used in ventilation work for public buildings, school houses and mills. The cloth screen type of filter is not available because of its liability to destruction by fire.

GAIN IN CAPACITY WITH COOL AIR.

As stated above, the safe load is based on a fixed maximum temperature attained by any part of the windings, which must be well below the critical temperature of the insulation. Cooling the air directly increases the capacity of the machine by allowing a greater temperature rise without exceeding a specified limit of temperature.

From curves giving the K. V. A. load on turbo-alternators as a function of the temperature of the entering air, it is shown, for example, that with air at 90° F. having a relative humidity of 45%, the safe capacity of the generator is only 87% of the full load rating. This is based on taking 100% load at 25° centigrade (77° F.) which is the standard air temperature for electrical machinery. If the air is passed through an air washer and cooler, it may be reduced to a temperature of 74° F. (23.3° C.) or less, enabling the generator to carry 102% load, resulting in a gain of approximately 15%, as the power required to operate the washer is but a fraction of 1% of the generator rating.

The amount that the air is reduced in temperature, depends on its temperature and humidity before it enters the washer. With higher initial air temperatures or lower humidities, the cooling obtained and, consequently, the gain in load carrying capacity will be greater. With average summer atmospheric conditions, the temperature of the air leaving the washer is usually between 60° and 70° F., which enables the generator to carry peak loads with perfect safety.

VALUE OF INCREASED CAPACITY.

An increase in the load carrying capacity of a generator means an increase in its earning capacity. The actual money value represented by a gain of only 5% on a 10,000 Kw. machine would be $5,000 for six months, based on a cost of $20. per kilowatt per annum, which does not take into consideration the saving in the cost of cleaning the generator. The gain in three months time on this basis would cover the cost of a washer installed complete, and provide a large return on the investment.

THE VALUE OF CLEAN AIR.

Few people realize the enormous quantity of air required for ventilating large turbo-generators. Assume, for instance, a moderately large generator using 65,000 cu. ft. of air per minute. This amount of air weighs approximately 2½ tons, so that within one-half to three-quarters of an hour a modern turbo-generator handles an amount of air equal in weight to its own total weight.

With 65,000 cu. ft. of air per minute passing through the machine, a total of 96,600,000 cu. ft. will be handled in twenty-four hours. As a rough approximation, it may be assumed that one hundred-millionth of the volume of the air in the vicinity of power plants consists of dust, dirt and other foreign particles. This would mean that 0.936 cu. ft. of dirt would pass through the machine in twenty-four hours, or 86 cu. ft. in three months. While, of course, a part of this dirt will pass directly through the machine, a portion will be deposited, due to the air swirls and eddies, in the air passages. As already pointed out, such deposits of dirt become a considerable handicap to the ventilation, as the quantity of air is decreased, due to the partial closing of the ventilating passages and the cooling effect of the air greatly diminished, owing to the fact that the air cannot come directly in contact with the heat-radiating surfaces.

EFFECT OF UNCLEAN AIR ON LIFE OF GENERATOR.

An item of even more importance, however, is the effect of unclean air on the life of the generator. A large percentage of all short circuits and burnouts of generators is due to foreign matter breaking down insulation resistance. Since a clean generator is comparatively free from such troubles, it is clear that an air washer may prevent a serious accident with a resulting loss many times exceeding the cost of its installation.

A 60,000 cu. ft. per minute Spraco washer is used to wash and cool the air for a 21,000 K. V. A. Westinghouse turbo-generator at the Long Island City, N. Y. plant of the Pennsylvania Railroad. The output of this one machine during the first twelve months of service, beginning January, 1915, was about 95,000,000 Kw-hours. That this machine was carrying its share of the load, is evidenced by the fact that 24 hours x 365 days x 21,000 K. V. A. x 80% P. F. is 147,000,000 Kw-hours, corresponding to a load factor of 64½%.

A D. C. voltmeter, connected with a copper strip exploring coil on the windings showed that not only were the windings cool, but that they were also free of foreign substances after fifteen months.

Only the highest grade of materials should be used in the construction of air washers used in this class of work, as the air in the vicinity of power plants usually contains elements which would cause rapid deterioration of inferior materials. In some localities the air is impregnated with various gases and matter soluble in water, which form the elements of a battery solution resulting in rapid galvanic action.

The Building of the Hospital*

With Segregated Costs of the Construction of Twenty-two Hospitals.

BY OLIVER H. BARTINE.

Superintendent of the New York Society for the Relief of the Ruptured and Crippled.

HEATING AND VENTILATING.

The degree of efficiency with which the building serves its purpose and is made comfortable and convenient depends most largely upon the character and completeness of its mechanical equipment. Quite as important also is the fact that the heaviest of the operating expenses of the hospital are those connected with the heating and power plant, and the extraordinary repairs and replacements necessary there.

Regardless of the differing views as to the status of artificial ventilation as applied to the hospital, there can be no disputing the fact that the heating plant of the hospital is a most important department. Provision must be made for the heating of the entire building and for a source of steam for laundry, kitchen and sterilizing work. Further, there should be thorough means of ventilating all toilets, kitchens (including diet kitchens), laundry and many other service rooms. Very few there are who do not believe in the importance of a complete artificial ventilating plant for the operating room. It is believed that the consensus of the best opinion also requires that there should be provided exhaust ventilation for all large wards, and in case of hospitals built in congested districts in the cities a supply of fresh air by means of an artificial ventilating system is also desirable.

A great deal is said of the success of natural ventilation, but it may be questioned whether the exponents of such a method of ventilation give proper consideration to the nuisance caused by open windows because of dust and noise, and to the effect of the dry air resulting from natural ventilation, as well as to the difficulty of controlling this method of ventilation.

Serious objections may be offered to any detail of the heating and ventilating equipment which is so arranged as to prevent thorough cleaning of all parts. To this end the hospital type of radiators should be used, these being constructed with an enlarged space between the radiator sections, and the radiators should be suspended from the walls with a space of not less than three inches, and preferably four inches, at the back of the radiators, and not less than five inches between the bottom of the radiators and the floor.

The ventilating grills should be so installed that they may be removed or be readily opened to permit of cleaning of the backs of the grills and the connecting ducts.

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*From a paper read before the American Hospital Association.

TABLE NO. 1a. COST DATA

Building.	Cubiture of building.	No. of patients.	Cu ft. per patient.	Total cost of building.			Cost of heat. & vent.			Cost of electric system.	
				Total.	Per cu. ft.	Per patient.	Total.	Per cu. ft.	Per patient.	Total.	Per cu. ft.
1....	2,096,000	225	9,320	$897,166	$0.428	$3,987.00	$86,461	$0.04	$384.00	$26,399	$0.012
2....	1,919,287	181	10,603	610,000	0.317	3,370.70	55,500	0.029	306.70	15,920	0.008
3....	1,687,000	152	11,098	525,000	0.311	3,453.94	41,660	0.025	272.00	12,962	0.007
4....	3,338,000	500	6,676	851,000	0.255	1,702.00	104,705	0.031	209.40	31,729	0.009
5....	4,230,103	450	9,400	1,736,739	0.41	3,815.00	141,137	0.033	313.60	27,632	0.006
6....	1,343,815	150	8,958	516,733	0.384	3,445.00	48,595	0.036	324.00	....	....
7....	756,355	150	5,042	251,081	0.332	1,606.00	26,452	0.035	175.00	9,594	0.013
8....	1,406,400	232	6,062	531,954	0.40	2,720.00	....	....	....	3,000	0.002
9....	508,375	70	7,262	214,164	0.44	3,061.00	10,855	0.018	155.20	....	....
10....	1,327,413	179	7,416	679,182	0.51	3,800.00	82,887	0.06	460.00	26,886	0.02
11....	905,800	250	3,623	599,220	0.44	1,600.00	46,000	0.05	184.00	7,600	0.008
12....	249,700	85	2,937	87,367	0.35	1,027.85	5,688	0.022	67.00	1,700	0.007
13....	210,300	—	—	74,945	0.35	—	4,600	0.022	—	2,500	0.011
14....	1,718,010	410	4,190	686,754	0.40	1,675.00	70,000	0.04	170.30	8,700	0.005
15....	1,877,931	350	5,337	789,795	0.42	2,256.60	52,180	0.028	150.00	49,501	0.024
16....	927,415	—	—	500,876	0.51	—	57,500	0.06	—	6,800	0.007
17....	534,150	—	—	394,000	0.73	—	*	....	—	1,100	0.002
18....	1,967,762	407	4,834	758,404	0.39	1,863.40	63,125	0.039	155.08	14,366	0.007
19....	3,768,282	303	12,440	1,366,780	0.36	4,510.80	137,000	0.037	452.14	20,875	0.006
20....	777,308	150	5,182	257,761	0.33	1,718.40	20.611	0.026	137.40	9,000	0.011
21....	367,200	110	3,340	146,521	0.40	1,332.00	3,000	0.008	27.27	3,200	0.009
22....	3,704,287	220	16,837	1,134,974	0.30	5,159.00	115,989	0.031	527.22	19,984	0.006
Avrge. cost p'r cu. ft..	......	...	....	......	0.382	....	....	0.033	....	....	0.009

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*In power plant.

[1]TABLE 1b. COST DATA

Building.	Cost of vac. cl. syst.			Cost of elevators.			Cost of laundry equipt.			Cost of kitchen equipt.		
	Total.	Per cu. ft.	Per patient.	Total.	Per cu. ft.	Per patient.	Total.	Per cu. ft.	Per patient.	Total.	Per cu. ft.	Per patient.
1....	—	—	—	$22,225	$0.016	$99.00	$9,729	$0.004	$43.20	$3,239	$0.001	$14.30
2....	$1,900	$0.001	$10.49	11,200	0.006	61.80	6,320	0.003	34.90	6,475	0.003	36.00
3....	—	—	—	3,360	0.002	22.10	5,956	0.004	39.11	4,000	0.003	26.32
4....	—	—	—	22,475	0.007	44.95	11,707	0.003	23.41	—	—	—
5....	2,603	0.006	5.70	32,280	0.008	71.73	20,713	0.005	46.00	13,802	0.003	30.70
6....	....	....	....	16.515	0.012	110.00	5,298	0.004	35.32	4,118	0.003	27.45
7....	....	....	....	2,450	0.003	16.30	3,575	0.005	24.00	....	....	....
8....	....	....	....	.....	....	....	4,954	0.004	21.40	9,000	0.006	39.00
9....	—	—	—	.....	....	....	—	—	—	....	....	....
10....	—	—	—	16,100	0.013	90.00	—	—	—	6,900	0.005	38.33
11....	....	....	....	8,000	0.009	32.00	....	....	....	....	....	....
12....	....	....	....	1,115	0.005	13.00	....	....	....	....	....	....
13....	—	—	—	.....	....	—	16,000	0.08	—	—	—	—
14....	5,575	0.003	13.60	6,200	0.005	15.12	....	....	....	....	....	....
15....	5,985	0.003	17.10	19,000	0.01	54.28	....	....	....	....	....	....
16....	2,400	0.002	—	8,000	0.009	—	53,382	0.059	—	—	—	—
17....	—	—	—	1,500	0.003	—	—	—	—	—	—	—
18....	3,625	0.002	9.00	7,625	0.004	18.73	....	....	....	....	....	....
19....	....	....	....	16,500	0.005	54.45	....	....	....	....	....	....
20....	4,500	0.005	30.00	9,000	0.01	60.00	....	....	....	....	....	....
21....	....	....	....	2,700	0.008	24.54	....	....	....	2,500	0.007	22.72
22....	....	....	....	5,855	0.0016	26.61	15,601	0.005	709.13	8,000	0.002	36.66
Avrge. cost p'r cu. ft..	....	0.0023	....	.....	0.007	....	....	0.017	....	....	0.0037	....

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[1] Provides capacity for several other buildings. [2] No piping included. [3] Large amount of piping involved.

—HOSPITAL BUILDINGS

Cost of electric system.		Cost of electric fixtures.				Cost of plumbing system.				Cost of refrig. plant. incl. boxes.		
Per patient.	Per outlet.	Total.	Per cu. ft.	Per patient.	Per fixture.	Total.	Per cu. ft.	Per patient.	Per fixture.	Total.	Per cu. ft.	Per patient.
$111.00	$16.50	$7,971	$0.003	$35.40	$7.00	$61,789	$0.029	$274.00	$226.40	$17,308	$0.008	$77.00
88.00	....	3,250	0.002	18.00	...	45,800	0.023	253.04	....	16,900	0.008	93.92
85.00	7.35	5,000	0.003	32.89	6.39	37,500	0.022	246.05	143.70	13,700	0.008	90.13
63.46	....	9,772	0.003	19.54	...	55,332	0.013	110.60	....	25,947	0.008	51.88
61.40	8.00	10,000	0.002	22.22	5.80	109,664	0.026	243.70	165.65	37,722	0.009	83.82
....	....	3,575	0.002	24.83	...	32,600	0.024	217.33	150.00	.....	....	....
63.90	10.90	2,180	0.003	14.40	6.00	23,000	0.03	153.00	135.00	5,300	0.007	35.50
14.90	....	....	....	....	...	....	....	....	....	.....	....	....
....	....	....	....	....	...	....	....	....	....	3,368	0.007	48.10
149.00	13.00	6,561	0.005	36.00	6.32	65,265	0.05	362.50	253.00	21,211	0.01	118.00
34.00	....	....	....	....	...	17,000	0.019	68.00	....	.....	....	....
20.00	....	....	....	....	...	6,200	0.025	73.00	....	443	0.002	5.21
——	....	....	....	——	...	2,525	0.012	——	....	.....	....	——
21.22	....	3,640	0.002	9.00	...	51,439	0.03	125.45	....	.....	....	....
141.50	....	9,750	0.005	28.00	...	72,840	0.04	208.11	....	40,000	0.021	114.30
——	....	1,744	0.002	——	...	85,000	0.09	——	....	62,000	0.066	——
——	....	....	....	....	...	10,000	0.018	——	....	.....	....	....
35.30	....	4,000	0.002	9.82	...	62,650	0.032	154.00	....	6,882	0.003	17.01
68.72	....	6,823	0.002	22.51	...	111,200	0.03	363.70	....	58,250	0.017	192.24
60.00	....	....	....	....	...	20,900	0.02	139.33	....	3,500	0.004	23.33
29.09	....	2,540	0.007	23.09	...	12,197	0.038	110.90	....	.....	....	....
90.83	....	5,938	0.002	27.00	...	102,614	0.019	467.00	....	7,433	0.002	33.80
....	....	....	0.003	....	...	....	0.029	....	....	.....	0.012	....

—HOSPITAL BUILDINGS

Cost of power plant.				Percentage contracts bear to total cost of building.										
Total.	Per cu. ft.	Per patient.	Per K.W.	Building.	Heat. & vent.	Electric.	E. fixtures.	Pl'bing.	Refrig.	Vac. cl'n.	Elevators.	Laundry.	Kitc'n.	Power plant.
$15,000	$0.007	$66.66	$75.00	72.2	6.9	2.9	0.9	6.9	1.9	—	2.5	1.1	0.4	1.6
7,400	0.004	40.90	30.00^{2}	73.4	8.1	2.6	0.5	7.5	2.8	0.3	1.8	1.0	1.0	1.0
7,078	0.004	46.50	70.78	75.2	7.9	2.5	0.9	7.1	2.6	—	0.64	1.1	0.76	1.3
15,440	0.005	30.88	44.11^{2}	67.1	12.3	3.7	1.1	6.5	3.5	—	2.6	1.4	—^{1}	1.8
21,570	0.005	47.90	95.86	74.26	8.1	1.8	0.6	6.4	2.1	0.15	2.6	1.4	0.79	1.8
.....	....	....	....	...	9.4	0.6	..	6.3	..	..	3.2	1.2	0.8	..
4,530	0.006	30.00	75.00	...	10.2	4.6	0.8	9.2	2.1	..	1.0	1.4	..	2.0
——	——	——	——	...	...	0.6	..	..	..	..	..	0.9	1.6	—
14,176	0.028	202.50	141.00^{2}	...	5.0	...	..	..	1.5	—	..	—	..	6.6^{1}
.....	....	....	....	...	12.0	4.0	1.0	9.6	3.1	—	2.4	—	1.1	..
.....	....	....	....	...	11.8	2.0	..	4.6	..	..	2.0	..	..	..
.....	....	....	....	...	6.9	2.0	..	7.0	0.5	..	1.3	..	..	..
——	——	——	——	...	6.1	3.3	..	3.4	—	—	—	21.3	—	—
.....	....	....	....	...	10.2	1.3	0.6	7.5	..	0.8	0.9	..	..	..
†	....	....	....	...	6.6	6.02	1.3	9.3	5.8	0.8	2.5	..	..	..
——	——	——	——	...	11.5	1.3	0.3	16.0	12.3	0.4	1.6	10.6	..	..
161,500	0.302	——	....	...	...	0.3	..	3.0	..	..	0.5	..	..	41.0
.....	....	....	....	...	8.4	1.9	0.5	8.3	0.9	0.5	1.0	..	..	..
.....	....	....	....	...	10.0	1.6	0.5	8.9	4.3	..	1.2	..	..	..
.....	....	....	....	...	8.0	3.5	..	8.0	1.3	1.7	3.5	..	..	..
.....	....	....	....	...	2.0	2.0	1.9	8.0	..	..	2.0	..	2.0	..
66,000	0.018	300.00	....	...	10.2	1.7	0.4	9.0	0.6	..	0.5	1.4	0.7	6.0
.....	0.047	....	....	72.44	7.2	2.4	8.0	7.6	2.9	0.80	1.76	3.9	1.01	7.0

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†In electric system.

POWER PLANT.

The question of the advisability of the installation of an electric power plant depends only upon the size of the hospital. Wherever fire room service for twenty-four hours is necessary and boilers of 100 H. P. capacity or greater are required, there can be little doubt as to the advisability of installing an electric power plant. In practically all hospitals steam at sixty pounds pressure is required for sterilizing purposes and also for laundry purposes. Steam also is required for cooking purposes at 40 pounds pressure. The piping system for the sterilizing and laundry work may be combined, but the cooking apparatus should be provided with a separate system of piping, while the heating is connected with still another separate system of piping. Thus the steam must be generated originally at 60 pounds pressure and be reduced to 40 pounds pressure for cooking and to approximately 2½ pounds pressure for heating purposes. It is just as easy and quite as economical to generate steam at 80 to 100 pounds, or even 125 pounds pressure, for the operation of engines for driving electric generators.

In the summer, when heat is not required, a considerable proportion of the exhaust steam may be utilized for heating

COST DATA TABLE Nº 2 HOSPITAL BUILDINGS

BUILDING		1	2	3	4	5	6	7	8	9	10	11	12	13		AVERAGE COST PER CU. FT.
CUBITURE OF B'L'D'G		905,800	249,700	210,300	1,327,413	1,718,010	1,877,931	327,418	534,180	1,967,762	3,768,282	777,500	867,200	2,036,000		
COST OF CONSTRUCT'N		320,620	72,221	49,320	441,682	541,214	540,539	224,050	219,900	594,131	1,016,132	190,250	120,304	647,045		
COST OF MECH. EQUIPM'T		78,600	15,146	25,625	237,500	145,540	243,256	276,826	174,100	164,273	550,648	67,511	26,137	250,121		
TOTAL COST OF B'L'D'G		399,220	87,367	74,945	679,182	686,754	783,795	500,876	394,000	758,404	1,566,780	257,761	146,821	897,164		
EXCAVATION	TOTAL	22,220	1,110	2,500	28,541	33,000	40,000	40.000	34,600	79,750	150,000	8,000	4,917	30,835		
	PER CU. FT.	.024	.004	.011	.025	.019	.021	.048	.065	.041	.056	.007	.013	.015		.026
MASONRY	TOTAL	111,700	25,216	23,420	175,503	260,989	196,760	31,080	108,900	243,147	417,085	71,680	53,684	222,870		
	PER CU. FT.	.12	.10	.11	.132	.152	.105	.098	.198	.127	.111	.092	.146	.12		.124
STRUCTUR'L STEEL & IRON	TOTAL	55,450	11,500	3,500	59,938	66,000	90,414	85,000	87,500	71,730	115,750	30,100	17,000	80,648		
	PER CU. FT.	.06	.05	.04	.045	.038	.048	.038	.070	.036	.031	.045	.046	.04		045
CARPENTRY	TOTAL	20,400	7,400	6,500	46,348	58,500	60,000	22,000	5,800	65,365	61,000	19,028	12,000	71,225		
	PER CU. FT.	.022	.03	.03	.035	.032	.032	.024	.018	.033	.016	.024	.033	.035		.028
ROOFING	TOTAL	18,000	5,800	3,000	9,700	8,319	48,365	4,100	9,500	13,825	41,687	In Steel & Iron	4,367	25,080		
	PER CU. FT.	.02	.02	.014	.007	.005	.026	.009	.018	.007	011	—	.024	.011		.010
GLASS & GLAZING	TOTAL	In Carpentry			In Carpentry	In Carpentry	In Carpentry		In Carpentry		36,000	1,000	400	6,202		
	PER CU. FT.	—			—	—	—		—		.0095	.001	.001	.003		.0036
FLASHINGS & SHEET METAL	TOTAL	In Roofing			In Roofing	In Roofing	In Roofing		In Roofing	In Roofing	In Roofing	8,525	In Roofing	In Roofing.		
	PER CU. FT.	—			—	—	—		—	—	—	.011	—	—		.011
PAINTING	TOTAL	5,000	1,095	950	In Carpentry	4,250	In Carpentry		In Carpentry	3,564	In Carpentry	In Carpentry	5,000	26,478		
	PER CU. FT.	.005	.005	.004	—	.002	—		—	.002	—	—	.014	.015		.006
LATHING & PLASTERING	TOTAL	10,000	2,660	1,750	16,500	22,800	20,000	6,000	400	20,225	37,800	15,000	10,060	41,237		
	PER CU. FT.	.01	.017	.008	.012	.013	.011	.007	.0008	.01	.01	.008	.027	.026		.0125
COMPOSITION FLOORING	TOTAL				18,103	29,000	14,000		5,000		29,000	8,750	In Masonry	8,106		
	PER CU. FT.				.01	.015	.008		.009		.008	.002	—	.004		.008
TILES. MOSAICS & MARBLE	TOTAL	46,000	17,000	1,200		18,200	31,000	1,500	800	41,260	65,600	11,000	2,686	63,029		
	PER CU. FT.	.05	.07	.006		.016	.017	.0016	.0015	.021	.0174	.014	.008	.031		.0211
HARDWARE	TOTAL	4,850	440	In Carpentry	In Carpentry	4,100	5,000	400	400	5,125	3,500	2,200	In Roofing	3,080		
	PER CU. FT.	.005	.002	—	—	.002	.003	.0004	.0008	.0026	.025	.0028	—	.004		.005
CAST IRON	TOTAL	27,000	In Steel & Iron	In Steel & Iron	30,000	45,036	35,000	20,000	21,800	44,210	35,000	18,000	5,500	44,189		
	PER CU. FT.	.03	—	—	.023	.023	.013	.022	.04	.022	.009	.024	.015	.022		.022
BRONZE & BRASS WORK	TOTAL															
	PER CU. FT.															
TOTAL COST PER CU. FT.		.44	.35	.35	.51	.40	.42	.51	.75	.39	.36	.33	.40	.420		.432

water for laundry purposes, for heating driers and for other purposes.

In many such plants the electric current is being made at a cost of one cent per K. W. H., and one of our largest New York hospitals made their electric current for ⅝c per K. W. H. In another of our New York hospitals an installation costing $17,000, and including electric power plant and refrigerating plant, resulted in a saving of $7,100 annually.

COSTS.

A great deal has been written concerning the cost of hospital buildings. Any statement of cost based upon the cost per bed may be misleading to the trustees, superintendent and others. For instance, a hospital caring for a special class of patients requiring extra rooms and special equipment cost $4,000 per bed. If the same building had been planned as a general hospital beds could have been placed in the special extra rooms mentioned, thus increasing the bed capacity of the building to such an extent that the cost of the building would not have exceeded $3,000 per bed. This hospital has special employees for special purposes and rooms, but perhaps not as many as would be required to care for the extra number of patients which might have been accommodated in the special rooms, but even after making liberal allowances for these conditions it is found that this hospital would not have cost over $3,300 per bed if used as a general hospital instead of $4,000 per bed as it actually cost, based upon the number of patients accommodated.

After making a careful study of this matter of costs the author has come to the conclusion that a better basis of determining the cost of the hospital building is the cost per cubic foot. In determining the number of cubic feet of the hospital, measurements should be taken from the basement or sub-basement (lowest) floor level to the mean of the outside of the roof, and from outside to outside of walls. In other words, the cubic feet of air displaced by the exterior dimensions of the building should be considered, eliminating approaches, balustrades and other projections not enclosing space.

It is true that it is quite possible to be wasteful in space, so that the cubic feet of space per patient may also well be given consideration.

In table No. 1 are presented segregated costs of the construction of twenty-two hospitals and hospital buildings. In the case of hospital No. 22 the cost per patient is shown to be $5,159, which is very high, while the cost per cubic foot is shown to be 30 cents, and this is very low.

It has been stated that no hospital building should cost in excess of 30 cents per cubic foot, but it will be observed by reference to this table that rarely is a general hospital built at such a low cost. The fact of the matter is that local conditions, the character of the hospital and its work, and the elaborateness of the structure must all be carefully considered in determining the price per cubic foot. Eliminating No. 17 (which is a boiler house), the cost per cubic foot of all of the hospitals listed averages .382 cent. The cost of the heating and ventilating equipment per cubic foot averages .033 cent (after eliminating No. 9, which included no boiler plant).

The cost of the electric system averages 1 cent per cubic foot; electric fixtures average .003 cent per cubic foot; plumbing averages .029 cent per cubic foot (omitting No. 16, which is a laundry building); refrigerating plants average .012 cent per cubic foot; vacuum cleaner systems .002 cent per cubic foot; elevators .007 cent per cubic foot; laundry equipment (excluding Nos. 13 and 16, which are purely laundry buildings) .004 cent per cubic foot; kitchen equipment .004 cent per cubic foot; power plants average .005 cent per cubic foot. Thus the construction of the building (exclusive of its fixed equipment) averages .273 cent per cubic foot, as shown by this list.

Table No. 2 gives a segregated statement of the cost of hospital buildings exclusive of equipment, in the case of thirteen hospitals.

In the case of certain items, as masonry, the cost per cubic foot corresponds very closely in the case of practically all of the hospitals listed.

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A PROPOSAL to change the name of the National Association of Master Steam and Hot Water Fitters deserves more than passing notice, not because it is likely to be adopted, but because it shows the trend in the development of this industry. As was stated in favor of the proposal, the general conception of a "fitter" is of a man who screws up pipe, and the use of the old-fashioned "master" in the title does not by any means convey an adequate meaning to the public. As was pointed out, the members of this association are not steam fitters or even master steam fitters. They are, at the least, heating contractors and many of them can lay claim to even a higher title.

Why, then, should the trade continue to do business under an outworn, misunderstood and clumsy title that does not properly represent its position or activities? Many heating contractors seldom see the jobs they have in hand and when visits are made to them, it is usually for the purpose of inspection and general supervision. These men fail to rise to the dignity of their calling when they are willing to pass in the general estimation as mere master fitters when they can rightfully assume the position of experts and contractors for the heating equipment.

Some such substitute as "The National Association of Heating Contractors," is suggested. This is practically as comprehensive as the longer name and has a force that is quite lacking in the present title.

The fact is that the heating trade, as well as the heating profession generally, has never fully risen up to its opportunities. It has too long been content to be a mere trade, rather than a distinct technical industry. Now, it would seem, is the opportunity to take a step forward in the interest of improving the status of the heating man, and while it would be a good thing to have the master steam fitters adopt the proposed title, it is even more important for the trade to begin to accustom itself to a more comprehensive designation.

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"WHAT is the matter with the steam fitting business?" asked President Bradley at the convention of the National Association of Master Steam and Hot Water Fitters. It may be that in the foregoing may be gained some inkling of the trouble. At any rate, with the growing practice of "delivering on the job" the heating contractor does not require the same quarters and equipment as in former days and some surprising instances may be seen of men who are doing an astonishingly large contracting business from a shop hardly worthy of the name.

It is becoming increasingly evident that the contractor of the future will do his work without the same "show" as in the past and he will need all the more to have his abilities and profession suitably designated to maintain his proper rank in the business community.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Twenty-Eighth Annual Convention, Atlantic City, N. J., June 21-24, 1916

As an occasion for plain speaking on the evils and shortcomings of the trade, the twenty-eighth annual meeting of the National Association of Master Steam and Hot Water Fitters will go down in history as one of the most remarkable of its kind ever held. In the presence of a notably large gathering, including many of the association's oldest members, the delegates were urged, as Judge John C. Karel, of Milwaukee, expressed it, to "get down to brass tacks," and instead of looking only for the abuses in the methods of the manufacturers, to frankly acknowledge their own faults and seek a way to correct them. "There is too much hypocrisy in your own ranks," declared Judge Karel. "You are too suspicious of your fellow-craftsman and your conceit leads you to believe that you are cleverer than your associate or competitor. So long as suspicion lurks among you, you will not be successful as a craft."

JUAN A. ALMIRALL,
President National Association of Master Steam and Hot Water Fitters.

Judge Karel also expressed the opinion that the name of the association was a misnomer and urged the members to get away from the term "fitter." "A fitter," he declared, "is a man who screws up pipe. You gentlemen are not fitters. You are heating contractors and this should be expressed in the title of your organization," a remark which brought forth a storm of applause.

OPENING SESSION, JUNE 22.

The convention met in the St. Charles Hotel, with President John T. Bradley in the chair. Following the meeting of the board of directors on Wednesday, June 21, the first regular session was called to order Thursday morning. Mayor Bacharach of Atlantic City welcomed the delegates and made a sally that was highly appreciated when he said that at the master plumbers' convention he was assured that there were no steam fitters present, only honest men, and here he was given equal assurance that there were no plumbers about, but only honest men.

President Bradley then presented his address. Following are some of the principal points he made:

With all sort of agitation about us; with various brands of legislation to confuse and confound us; with all kinds of difficulties to contend with, we ought to be thankful that we are permitted to assemble and talk over our own affairs.

"What is the matter with the steamfitting business?" is a question repeatedly asked.

Is it getting the return that its investments and efforts merit? Are the times and conditions to blame, or should we look to ourselves to determine what is to be done to make the results worthy of the effort put forth? Are we wasteful? Are we ignorant? Do we understand our business? If this convention can answer some of these questions and offer suggestions that will be beneficial, who can then say that, besides its many activities, the National Association of Master Steam and Hot Water Fitters is not of the greatest possible service?

There is one subject that crops up continually at meetings or conventions which seems to hold the attention no matter what line of business the association represents. It is "co-operation between the wholesaler and the retailer," and as we are the retailers and the manufacturers are the wholesalers why not try to find a way that is morally and legally right for us to co-operate? And who needs most protection from the inroads of all kinds of pernicious interference? Why, it is the master steam fitter in the medium-sized town throughout the country.

Again we say, if a proper way can be found by which mutually satisfactory co-operation between National Associations in our line of business can become effective, then will this National Association have done for the craft and the public that which it is impossible to accomplish as individuals—but we do not, any of us, wish to run counter to what is just or lawful. We can, however, express the hope that the day is not far distant when through the Federal Trade Commission, perhaps, or some other Governmental source, we will be helped and not hindered in effort to place the business of steamfitting on a basis where it will produce a living and something besides for those who risk their capital, small or large, and who give up their best years in its conduct.

We everyday business men want to co-operate—not only with the Government, but with each other in placing our own business in a position to serve our customers both by furnishing high grade quality of goods and excellent service. All of this can be helped by co-operation.

The objective of our association is not only that men in our line of business shall receive but that they shall give—give in service for others. And we can point with considerable pride to unselfish giving by men who had a part in the inauguration of this association some twenty-eight years ago, and some of them are members to-day.

The National Association does not attempt the influencing of either National or State legislation, but it does give such close attention as is consistent to legislative matters at times, and co-operates with other associations, making legislative matters a specialty; on matters that affect the craft.

We must not be at all discouraged because everything desirable to accomplish has not become a fact, even after a few years' efforts have been expended.

The substantial character of our membership is a subject for congratulation, particularly in view of the peculiar conditions that have prevailed during the last two years. Our membership is not far from its high-water mark and such losses as we have sustained have been offset, to a large degree, by additions of members from quarters where we have not heretofore been actively represented.

The financial position of the association is stronger than we had reason to hope for when the business conditions in our line are taken into consideration and allowances made for the failure to meet obligations by members who should have done so before April 30, when our books for the fiscal year closed.

Not wishing to anticipate other reports to be presented at the proper time, I will be content to say that it is a source of great gratification to have our treasurer and secretary inform us that never in the history of the association, so far as they know, have the good assets exceeded the liabilities by such a substantial amount as will be shown by their reports.

On the conclusion of his address President Bradley introduced Judge John C. Karel, of Milwaukee, who was one of the principal speakers at the association's convention in Milwaukee last year.

Judge Karel commenced his remarks by paying a tribute to the retiring president, Mr. Bradley, and referred to his loyalty to the association, especially during the years when he was the sole representative in St. Louis. "When Mr.

Bradley could not induce his associates in his home city to see the advantages of association work," said Judge Karel, "he was not the kind to lose heart, but went ahead and held a convention by himself, being chairman and all the other officers as well. He stuck to his guns and to-day he has the satisfaction of seeing a score or more of delegates from St. Louis present at this convention."

Judge Karel then presented President Bradley, on behalf of the association, with a gold watch and gold pocket knife. As Mr. Bradley rose to receive the gifts he was greeted with prolonged applause which testified even more strongly to the esteem of his associates.

He was noticeably moved by the ovation accorded him, but found words to express his thanks. "Most men," he said, "have to die to learn how much they are appreciated. I am lucky in that respect and I thank you."

JUDGE KAREL'S ADDRESS.

Judge Karel then proceeded with his formal address, which took the form of a thoughtful review of the association, its defects, its needs and its opportunities. Convention-goers, he said, may be divided into three classes: (1) the earnest workers; (2) those who consider the convention a clearing house for ideas, where business yarns are swapped and experiences told, and (3) those who know little and care less, who look upon the convention simply as an outing. The first two classes derive benefit from the convention, but the third class is wasting its time as far as furthering their business interests is concerned.

Heating contractors must find a way to be successful. You should have organizations in every State, instead of in six. Last year in Wisconsin 28 bills detrimental to the heating contractors' interests were killed by the Milwaukee association.

Turning to the shortcomings of heating contractors, Judge Karel said: "There ought to be no question about honor among you and yet when one of your number presents a report containing anything new or different, many of you ask yourselves, 'I wonder what he had in his mind when he wrote that.' You are often looking for some ulterior purpose. There is a constant lack of confidence among yourselves. You are not playing the game with all the cards above the table. As long as this suspicion lurks among you, you will not be successful as a craft."

Judge Karel put himself in the place of the manufacturer and asked how the contractors could expect generous treatment from them when they were not themselves playing fair towards the manufacturer.

"In the awarding of contracts, I believe in competition, but is not reputation an asset to be considered? There ought to be some other way of awarding contracts than by giving them to the lowest bidder. I would recommend a system of cost plus a percentage. This I tried out in a modest way in the construction of my own home in Milwaukee, and it worked successfully. The only trouble arose over the carpentry work, and that was the one item that was done on the low-bid basis."

Judge Karel's address was easily the sensation of the convention, and while many felt he had been unsparing in his criticism, at the same time he had given expression to ideas that had long been known to the members themselves but generally avoided in convention discussions.

F. W. HERENDEEN'S ADDRESS.

The next speaker was F. W. Herendeen, secretary of the National Association of Boiler and Radiator Manufacturers. Mr. Herendeen delivered a prepared address which, he said, had been approved by his association. He bespoke a deeper appreciation, on the part of the heating contractors, of the work of the boiler and radiator manufacturers' association. He said that during the past year no less than forty bills had been introduced in eight State legislatures relating to some features of the trade. These included bills for the compulsory inspection of house heating boilers and State licenses for firemen. His association was organized to keep watch of such impending legislation and had been successful in many cases in blocking it. The association was also interested in seeing that nothing detrimental was added to the recently enacted A. S. M. E. boiler code, especially on the part of the boiler insurance companies.

He said the association had four freight classification committees in the country for the purpose, among other things, of opposing improper rates. This matter, he said, was of just as much importance to the heating contractor as it was to the manufacturer, for the payment of excessive freight rates was a burden that affected both parties.

Mr. Herendeen urged an interchange of thoughts and ideas on the part of the two associations and said that one of the reasons why steam and hot water heating is not more generally on a profitable basis is because the items of cost, overhead expense and profit are not properly co-ordinated. Of a year's failures in the heating contracting trade only 5.7 per cent. were due to competition, the great majority being caused by incompetence and lack of capital.

According to the way many contractors are running their business, the manufacturer capitalizes the contractor, without interest. Contractors who expect this accommodation should be prepared to furnish the manufacturer with financial statements.

Mr. Herendeen said the capital invested in the heating industry was notably moderate compared to the amount of business transacted. The merchant should make his bank a partner in his business. "Discuss your affairs," he urged, "with your bank."

Another point taken up by Mr. Herendeen was the use and abuse of discounts. Many people are not aware of the fact, he said, that they can borrow money at 6 per cent. interest and discount their bills and come out ahead. One of the principal abuses in the trade is the delay in taking discounts, as it works a hardship not only on the contractor, but on the manufacturer as well.

Mr. Herendeen included in his paper a list of the members of the National Boiler and Radiator Association, as follows:

American Radiator Co., Chicago, Ill.
Atlantic Radiator Co.
Boynton Furnace Co., New York.
W. A. Case & Son Mfg. Co., Buffalo, N. Y.
Gurney Heater Mfg. Co., Boston, Mass.
Hitchings & Co., Irvington, N. Y.
International Heater Co., Utica, N. Y.
Kewanee Boiler Co., Kewanee, Ill.
Lord & Burnham Co., Irvington, N. Y.
J. H. McLain Co., Canton, O.
L. J. Mueller Furnace Co., Milwaukee, Wis.
National Radiator Co., Johnstown, Pa.
Niagara Radiator & Boiler Co., No. Tonawanda, N. Y.
Federal Radiator Co.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Richardson & Boynton Co., New York.
Richmond Radiator Co., New York.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
Thatcher Furnace Co., New York.
Union Radiator Co.
Utica Heater Co., Utica, N. Y.
Williamsport Radiator Co., Williamsport, Pa.

Committee Appointments.

The following committee appointments were announced:

CREDENTIALS.

Harry G. Black, Pennsylvania; Theodore M. Hunt, Missouri; Robert Berla, New Jersey; E. A. Wheeler, Maine; Charles J. Fox, Wisconsin.

NOMINATING.

Alfred E. Kenrick, Massachusetts; Frank H. Meadows, Wisconsin; William Hunter, Missouri; W. F. Hughes, Pennsylvania; Ernest T. Child, New York.

CONSTITUTION AND RULES.

N. Loring Danford, New York; J. Hokom, California; Edward Kanney, Indiana.

APPEALS AND GRIEVANCES.

Frank G. Carthey, Utah; L. B. Brickenstein, North Carolina; Walter Klie, Ohio.

ASSOCIATION IMPROVEMENT.

J. A. Ziesse, Michigan; S. A. Meeker, Connecticut; William Eckert, Washington.

AUDITING.

Charles A. Geoghegan, New York; Earnest T. Child, New York; William H. Curtin, New York.

DISTRIBUTION OF REPORTS.

Elias D. Smith, New York; James Barry, Missouri; Theodore Karr, Jr., Illinois.

RESOLUTIONS.

Stewart A. Jellett, Pennsylvania; Robert S. Parks, Massachusetts; Horace W. Jones, New York.

AFTERNOON AND EVENING SESSIONS, MAY 22.

A feature of the afternoon session was an address by Dr. Hobert C. Dickinson, physicist of the Bureau of Standards, in Washington, on the work of that department. His address was illustrated by lantern slides. One of the principal functions of the Bereau of Standards is to make tests of materials used in its specifications for government work. The testing apparatus includes appliances for measuring heat transmission losses, and Dr. Dickinson said that the methods used and the accuracy of the results obtained compared favorably with the best practice, including the methods used in France, Germany and England.

In the evening an illustrated lecture on the navy and preparedness was delivered by Captain Charles L. Poor, field secretary of the Navy League of the United States. The Navy League is working for a higher state of preparedness and efficiency in the navy and the lecture was a plea for greater interest in this matter.

FRIDAY SESSION, MAY 23.

After an executive session in the morning, the convention met at 2 o'clock for the election of officers. The following were unanimously elected:

NEW OFFICERS.

President, Juan A. Almirall, New York.

Vice-presidents, W. H. Oakes, Boston, Mass.; Frank G. Carthey, Salt Lake City, Utah, and Edmund Grassler, Milwaukee, Wis.

Treasurer, J. E. Rutzler, New York.

Board of directors, John T. Bradley, St. Louis, Mo.; Noble P. Bishop, New Haven, Conn.; N. Loring Danforth, Buffalo, N. Y.; Julius A. Ziesse, Grand Rapids, Mich.; Juan A. Almirall, New York; W. H. Oakes, Boston, Mass.; Frank G. Carthey, Salt Lake City, Utah; Edmund Grassler, Milwaukee, and J. E. Rutzler, New York.

Sergeant-at-arms, John C. F. Trachsel, Philadelphia, Pa.

The retiring president then called Past President Elias D. Smith to the chair to install the new officers, and he performed this duty with a touch of military discipline that was apropos of the times.

An address by Edward N. Hurley, chairman of the Federal Trade Commission, was read by Sercetary H. B. Gombers. Mr. Hurley had expected to present his address in person, but was detained in Washington. Mr. Hurley called special attention to the present attitude of the government toward business and spoke of the government's constructive aid which was being found to be more helpful than court actions. Business data of all kinds are being gathered by the commission which will be distributed as widely as possible for the benefit of business men.

"The Relation of the Architect and the Master Steam Fitter" was the subject of an address that concluded the open session of the convention. This address was delivered by W. Knickerbacker Boyd, fellow of the American Institute of Architects, and discussed the matters of separate contracts and the use of manufacturers' names or brands in specifications.

After a further executive session the convention adjourned.

A subsequent meeting of the new board of directors was held at which N. Loring Danforth was elected chairman of the board and H. B. Gombers was reelected secretary.

Convention Notes.

One of the notable absentees from the convention was William G. LeCompte, of Jenkins Bros., who, as chairman of the Manufacturers' and Salesmen's Entertainment Committee, had for many years been in charge of the entertainment programme. Mr. LeCompte had made all the preliminary entertainment arrangements, but was called away on the opening day by the mobilization order for the National Guard. Mr. LeCompte is assistant quartermaster of the Seventh Regiment, N. G. N. Y., his regiment being among the first to leave for the border.

Arthur Ritter, of the American Blower Co., was chosen chairman of the Manufacturers' and Salesmen's Entertainment Committee, to take the place of Mr. LeCompte, and, with Secretary J. Barton Garfield, successfully carried out the plans made.

Those who contributed to the entertainment fund included: National Radiator Co., Pierce, Butler & Pierce Mfg. Corporation, Gurney Heater Mfg. Co., United States Radiator Co., Jenkins Bros., Westinghouse Electric & Mfg. Co., Kewanee Boiler Co., H. B. Smith Co., Sprague Electric Works, American Radiator Co., American Blower Co., Richmond Radiator Co., Fowler & Wolfe Mfg. Co., Keasbey & Mattison Co., Johnson Service Co., Warren Webster & Co., Hoffman Specialty Co., H. W. Johns-Manville Co., Cutler-Hammer Co., Consolidated Engineering Co., Brogan & Co., Haynes Selling Co., Kanawha Mfg. Co. and Federal Radiator Co.

At a meeting of the "Old Guard," which is composed of past officers and directors of the National Association of Master Steam and Hot Water Fitters, held in the St. Charles, Wednesday evening, June 21, the following were present:

Past presidents: Charles A. Geoghegan, New York; P. Gormly, Norristown, Pa.; Stewart A. Jellett, Philadelphia; Alfred E. Kenrick, Brookline, Mass.; John T. Sadler, Elmira, N. Y.; Elias D. Smith, New York, and Past Director George H. Zellers, Washington, D. C.

Present officers: J. A. Almirall, New York; N. P. Bishop, New Haven, Conn.; John T. Bradley, St. Louis, Mo.; Frank G. Carthey, Salt Lake City, Utah; N. Loring Danforth, Buffalo, N. Y.; Edmund Grassler, Milwaukee, Wis.; William H. Oakes, Boston, Mass.; J. E. Rutzler, New York; Julius A. Ziesse, Grand Rapids, Mich.; Henry B. Gombers, New York, and John C. F. Trachsel, Philadelphia, Pa.

The "Old Guard," through Elias D. Smith, "captain of the Guard," sent a message of greetings to "Quartermaster Bill LeCompte" as follows: "The Old Guard of the National Association of Master Steam and Hot Water Fitters, convened at Atlantic City, send gretings to you in the enforced separation. We admire your patriotism, rejoice in your prompt response to the call of duty, deplore our loss and pray for your safety. 'We will meet, but we will miss you, very, very much."

The presence of over 100 ladies added greatly to the success of the convention. On Thursday they held an indoor golf tournament on the miniature course on the Garden Pier, A. S. Armagnac, J. Barton Garfield, R. B. Hunt and C. S. Wood directing the play. The prize winners were Mrs. J. E. Rutzler and Mrs. Charles A. Geoghegan. In the evening, under the direction of H. G. Issertell, the ladies were escorted to the Steel Pier, where dancing was indulged in, the party adjourning later to a midnight luncheon at the Isleworth.

Several local attractions, including a baby parade and a fancy float parade vied with the attractions that had been provided for the ladies, but all were on hand for the bowling tournament Friday evening. This event consisted of a team match between the manufacturers and contractors, a tournament for the ladies and an open tournament for members. Chairman Ritter and Captain Garfield were assisted in handling the various events by H. G. Issertell and Frank K. Chew. The Manufacturers and Salesmen won the team match, the winning players being C. A. Miller, Frank Martin, A. Ritter, W. M. Cosgrove and C. S. Wood. On the contractors' team were Messrs. Wenzel, Netz, Bower, Jones, Jellett and Danforth. W. H. Driscoll won the open tournament for members and the winning ladies, in order, were Mrs. Wenzel, Mrs. Netz, Mrs. Quilty, Mrs. Ritter, Mrs. Child, Miss Rutzler, Mrs. Sheldon, Mrs. R. Roberts, Mrs. Curtin, Miss Wallace and Mrs. Brogan.

After the contest the party returned to the St. Charles, and the retiring president, Mr. Bradley, presented the prizes, provoking much merriment through his efforts to influence the choices of the prizes by the winners.

Many expressions of regret were heard over the death of W. D. Weaver, who has for many years acted as official stenographer for the convention.

Though not strictly a part of the meeting, the tournament of the Eastern Trade Gold Association held June 21, at the Atlantic City Country Club, attracted many of those at the convention. Twenty-eight players competed for the silver cup presented by James D. Erskine, of the American Radiator Company, which was won, in a match against bogey, by Joseph Geoghegan, of New York. Other winners were W. F. Stearns, R. T. Potts, G. M. Scott, the president of the association; G. H. Chasmar and E. L. Bortner.

Among the Manufacturers.

The following were noticed among the manufacturers' representatives present:

Warren Webster & Co., Camden, N. J.: Warren Webster, E. Kessler Webster and E. K. Lanning, Camden; George Eagan, Philadelphia; L. H. Quackenboss, New York.

American Radiator Co., Chicago, Ill.: Charles K. Foster, Chicago; James D. Erskine, W. M. Cosgrove, J. Barnum, J. Barton Garfield, New York; W. F. Stearns, Boston; W. A. Blank, Philadelphia.

Jenkins Bros., New York: Frank Martin, New York, and J. D. Stiles, Boston.

Monash-Younker Co., Chicago, Ill.: Louis P. Monash.

American Blower Co., Detroit, Mich.: Arthur J. Ritter, New York.

H. B. Smith Co., Westfield, Mass.: C. A. Miller, New York; G. H. Chasmar, Washington; H. D. Kellogg, Thomas C. Brunt and William H. Jackson, Philadelphia.

Pierce, Butler & Pierce Mfg. Corporation, New York: E. F. Glore, J. J. Kelly, R. L. Leslie and Leon T. Fest, New York; E. H. Giles, R. S. Auffort and Paul Dewees, Philadelphia.

Sprague Electric Works, New York: H. G. Issertell.

Federal Radiator Co., New Castle, Pa.: George W. Barr.

M. E. Conran Co., Brooklyn, N. Y.: M. E. Conran.

Johnson Service Co., Milwaukee, Wis.: Frederic E. W. Beebe and Frank Shay, New York.

J. L. Mott Iron Works, New York: J. J. Blackmore.

United States Radiator Corporation, Detroit, Mich.: H. T. Cole and E. E. McNair, Detroit; C. P. Hackett, Philadelphia; A. H. Ross, New York.

J. D. Johnson Co., Brooklyn, N. Y.: William T. Gilmour.

Kewanee Boiler Co., Kewanee, Ill.: H. E. Purcell, salesmanager; Homer Addams, New York, and E. P. Bradley, St. Louis.

Hoffman Specialty Co., Chicago, Ill.: E. S. Storms, New York.

International Heater Co., Utica, N. Y.: President Frank B. Wheeler.

Molby Boiler Co., New York: E. C. Molby.

Kanawha Mfg. Co., Charleston, W. Va.; J. B. Bernhard, Charleston; J. F. Siegel, New York.

Penn Engineering Co., Philadelphia, Pa.: Harry Hellerman.

Greenfield Tap & Die Co., Greenfield, Mass.: Harvey S. Ashmun.

Keasbey & Mattison Co., Ambler, Pa.: C. S. Wood, Newark, N. J.

Richmond Radiator Co., New York: P. M. Beecher.

Speakman Supply & Pipe Co., Wilmington, Del.: Albert G. Weber and Joseph H. Dallett.

Vapor-Vacuum Heating Co., Philadelphia, Pa.; A. E. Kriebel.

Haynes Selling Co., Philadelphia, Pa.: C. F. Haynes.

Johnson Vapor Heating Co., Boston, Mass.: John M. Sewall.

Isaac A. Sheppard & Co., Philadelphia, Pa.: A. W. Proctor and H. K. Lodge.

Bishop-Babcock-Becker Co., Cleveland, Ohio: William W. Morgan, New York.

Bridgman Bros., Philadelphia, Pa.: Frank C. Eckfeldt, G. Wobensmith, H. H. Blake, Charles N. Moore and T. J. Sommers.

Brogan & Co., Philadelphia, Pa.: J. Brogan.

New Jersey State Association.

New officers were elected as follows at the annual meeting of the New Jersey Association of Master Steam and Hot Water Fitters, held in Newark, N. J., May 24; President, T. B. Cryer; vice-president, J. S. Boyce, Asbury Park; secretary-treasurer, Harry Geiser; directors: George Turner, Asbury Park; George S. Kappel, Camden, and Walter Lawson, Newark.

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National Association of Master Plumbers.

David H. Roberts, of Cleveland, Ohio, was elected president of the National Association of Master Plumbers at its recent annual convention in Atlantic City. Mr. Roberts served last year as vice-president. Other officers elected were: Vice-president, L. McNamara, St. Louis; treasurer, William McCoach, Philadelphia. President Roberts appointed E. Ellen, of Cleveland, as secretary.

In the matter of the litigation against members of the association in Des Moines, Salt Lake City and Erie, President Cassedy, in his annual report, stated that "as yet no decision has been handed down by the Court of Appeals and we can only wait and hope that this court may arrive at a full and complete understanding of the real purposes of our association."

Nearly 1,000 members and guests were present.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Final Arrangements for Mid-Summer Meeting.

Due largely to the activities of the newly organized Michigan Chapter, a most attractive program has been arranged for the mid-summer meeting of the American Society of Heating and Ventilating Engineers, in Detroit, Mich., July 19-21. A special invitation is extended to the members to bring the ladies, elaborate arrangements having been made for their entertainment and comfort. Headquarters will be at the Hotel Statler.

Wednesday, July 19, will be taken up with registration and a session in the morning, a luncheon at noon in the room adjoining the convention hall (with a luncheon for the ladies at the Fellowcraft Club) and an afternoon session. In the evening there will be an informal dinner dance at the Fellowcraft Club.

Thursday, July 20, will be devoted to the trip to the University of Michigan, at Ann Arbor. There will be one session at the university and Professor John R. Allen. president of the Michigan Chapter, will show the delegates some interesting things in connection with the work of his testing laboratory. The Ann Arbor committee has arranged for an organ recital in the Hill Auditorium. The return trip to Detroit will be made at 5:30. In the evening there will be a moonlight dance on the steamer "Pleasure."

The final session will be held Friday morning, July 21, and the afternoon will be taken up with sight-seeing trips and visits to industrial plants in Detroit.

The papers to be presented will include the following:

"Heat Transmission Through Building

Materials," by Professor John R. Allen, recounting the results of his recent tests.

"Testing Hot Air Furnaces," by R. W. Davenport, mechanical engineer for the Detroit Stove Works.

"Heating a Conservatory and Greenhouse," by Professor J. D. Hoffman.

"Clean, Pure Air for Our Cities," describing the operation of a cinder collector on the top of a chimney in New York City.

"Ventilation of Garages," by C. W. Obert.

"Test of Sectional Valves," by J. A. Donnelly.

"Engineering and Cost Data Relative to the Installation of Steam Distributing Systems in a Large City," by F. H. Valentine.

In addition to the chapter reports, there will be an interesting committee report, Professor W. F. Vernon, chairman, on "Best Place in Room for Radiator."

Professor Ensweiler is preparing a paper on "Test of Velocity of Flow in Galvanized Ducts," which, it is hoped, will be ready in time for presentation at the meeting.

New Year Book.

A new year book of the heating engineers' society has been published, containing lists of members, officers and committees, as well as the society's charter, constitution and by-laws. There is also a list of past officers, calendar of past meetings and a list of the papers read before the society. The new arrangement adds greatly to the convenient use of the year book which was published under the direction of Secretary C. W. Obert.

This list of members, corrected to April 1, 1916, now totals 705, including all grades.

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Organization of Ohio Steam Heating Association.

A new organization in the heating trade has been formed in Ohio by some fifty contractors and manufacturers' representatives, with the purpose of developing a state-wide plan of publicity, by means of newspaper advertising and personal solicitation among city, county and state officers, in the interests of steam and hot water heating. The members are agreed that there is urgent need of acquainting prospective builders with the advantages of steam and hot water heating.

The organization will be unique in having no affiliation with any other body, either state or national. It is also announced that it will have nothing to do with labor matters and will not attempt to arrange prices. The object of the association, as stated in its constitution, is "to further the interests of steam and hot water heating of public and private buildings of all types, and to educate school boards and building committees of state, county and city of public and private buildings to the use of steam and hot water for heating purposes, and to secure just and meritorious legislation covering the use of steam and hot water for heating purposes and sanctioning the use of direct-indirect radiation in all public and private buildings."

The officers of the association, elected at the organization meeting, held in Columbus, June 6, are: President, Frank H. Field, Columbus representative of the McGinnis Co., Pittsburgh; first vice-president, W. H. Conklin, of W. H. Conklin Co., Columbus; second vice-president, J. W. Bryce, Springfield; secretary-treasurer, A. W. Miller, Columbus representative of the Peerless Heating Co., of Pittsburgh. Mr. Miller will also act as the association's business manager. The members of the executive committee are: E. H. Hannaford, Peck, Anderson & Peck, Cincinnati; D. J. Sweeney, Urbana; W. J. Schall, Youngstown; J. F. Bartholomew, of Bartholomew Bros., Zanesville, and O. J. Wheeler, of the Esswein Co., Columbus. General direction of publicity will be in the hands of President Fields and Secretary Miller.

The permanent headquarters of the association will be in Columbus. Active members will pay $50 a year dues and associate members, $40 per year. The educational nature of the organization is indicated in the announcement that an early meeting will be devoted to technical papers and discussion.

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Sidewalk Ventilation Gratings on Broadway, New York, Barred.

The long fight waged by Broadway business and real estate men to prevent the use of sidewalk ventilation gratings in connection with the New York subway was partially won recently when the Public Service Commission, on recommendation of Henry W. Hodge, voted to eliminate these gratings in the new subways along Broadway between Twenty-ninth and Thirty-fifth streets and between Thirty-ninth and Forty-sixth streets. The gratings between Thirty-fifth and Thirty-ninth streets will have to remain, as it is impossible to replace them on account of the long distances to the nearest ventilating chamber.

In place of the sidewalk gratings, Commissioner Hodge has recommended the installation of ventilating chambers at three points between Twenty-ninth and Forty-sixth streets. One chamber will be in Greeley Square under the elevated structure there and erected on a "safety isle" to be built between the tracks. Another chamber will be placed behind the Dodge statue in Herald Square and the third in the triangle just south of the junction of Seventh avenue and Broadway.

In his report Commissioner Hodge said:

"While the regulation of air currents in this subway is not, in my opinion, capable of absolute control, owing to the uncertainties of the piston action of trains in opposite directions, the openings in the division walls, the station entrances, emergency exit openings and other factors which prevent exact mathematical calculation, yet I am of the opinion that by introducing fans and a ventilating duct near Forty-second street and similar fans and a ventilating duct near Thirty-first street, the portions of the subway between Twenty-ninth street and Thirty-fifth street, and between Thirty-ninth and Forty-sixth streets can be properly ventilated without sidewalk gratings.

"While I am of the opinion that the two fan outfits and these gratings in open spaces will properly ventilate these portions of the subway, I feel that it will be safest to preserve the present ventilating chambers between Thirty-ninth and Thirty-second streets, so that, in case the ducts do not give satisfactory ventilation, gratings can be restored over these vent chambers, as also over the openings above the station between Thirty-ninth and Forty-second streets.

CORRESPONDENCE

The Danger of Excessive Humidity in the Air Supply.

Editor Heating and Ventilating Magazine:

From our work in air washing and humidifying lines we have come to the conclusion that much higher humidities are being specified than are advisable. Practically all of the reports that we have studied covering the work of investigators on heating and ventilating and air conditioning show that in an auditorium that is to be occupied by a large number of people there is never a lack of proper humidity and almost always a state of excessive humidity. The vapor given off by the bodies of the occupants soon brings about a condition of relative humidity much higher than need be or advisable, with the result that the feeling of discomfort is more easily produced because the wet bulb temperature rises, making the evaporation from the skin less rapid, with a consequent tendency to increase the skin temperature, thereby causing discomfort.

It seems quite contradictory to send tubercular patients to the mountain altitudes and to localities of very low humidity and at the same time to insist upon children being kept in schoolrooms for several hours a day with air supplied at humidities of 50% at 70° F. which frequently results in humidities maintained in the room higher than 70%.

F. R. Ellis.

Boston, Mass.

COMMENTS OF DR. THOMAS R. CROWDER, DIRECTOR OF THE DEPARTMENT OF SANITATION AND SURGERY OF THE PULLMAN COMPANY.

It is commonly asserted that dry air is harmful. The truth of this statement has not been proven, although much engineering practice has been based on the assumption of its truth. It is a matter of common experience that many of the elaborate devices for conditioning air have failed of their purpose to create comfort in spite of their ability to maintain the desired degree of humidity.

About all the exact knowledge we have concerning the physiological effects of humidity is that much moisture in the air is harmful. This is certainly true when temperatures are high; whether it holds through the lower thermic scales has not been clearly shown. Rubner, one of the greatest of hygienists, makes the statement that the body does best in an atmosphere of low humidity.

It is almost beyond question that the effects of air on the body are to be explained wholly on the basis of thermic relations. Humidity is one of the three elements controlling the thermic effect of air on the body, the other two being temperature and motion. Within certain limits, varying any one of these qualities can be entirely compensated for by changing the other two. So it would not seem that any absolute standard either of humidity, or temperature, or motion, is possible. Neither is it possible, in my opinion, to establish an absolute standard of combined humidity, temperature and motion, for the simple reason that perfect uniformity of atmospheric conditions is not desirable. The constant stimulation of the skin which is induced by constantly varying its atmospheric environment contributes both to comfort and to healthy physiologic responses.

It is not probable that the alleged drying effect on the mucous membranes of air with low humidity is real, but that the effects so ascribed are rather due to too high a temperature, or to such a combination of temperature, motion and humidity as fail to accomplish a normal amount of heat elimination from the body and so break the thermic balance on which a proper distribution of blood depends. We do not get this drying effect from breathing cold air, although cold air contains very little moisture and takes up much from the lungs. The amount of water vapor given up by the mucous membranes of the respiratory tract to the air passing over them depends on the absolute amount of moisture in the air and not on its relative proportion. Whether the air is taken in cold or warm, it comes out essentially at the temperature of the body and essentially saturated with water vapor. Thus in the winter time we give up the same amount of moisture with each breath whether we are breathing the outside air at a temperature below freezing or the same air after it has been brought inside and warmed to 70° F. This is a fact which seems to have been quite lost sight of in the discussion of humidity.

VIEW OF DR. M. J. ROSENAU, DEPARTMENT OF PREVENTIVE MEDICINE AND HYGIENE, HARVARD UNIVERSITY MEDICAL SCHOOL.

There is no doubt that excessive heat and humidity are injurious to health and decrease efficiency, but the subject is still too young to make any statement with finality. There are factors still not understood.

Cost of Removing and Replacing Pavements.

Editor HEATING AND VENTILATING MAGAZINE:

In THE HEATING AND VENTILATING MAGAZINE for May there appears an article by W. F. Verner on the cost of removing and replacing pavements incident to installing heating lines in city streets.

Do you understand that the table appended to the article applies to New York City conditions? I assume that it does, on account of the wages of the men and the cost per lineal foot, which agree very closely with prices and costs in New York City, but, so far as I know, there is no other place in the United States where the costs are so high as they are here. If they are as high elsewhere, I should be very glad to know of it.
CHARLES N. GREEN.

New York, N. Y.

REPLY BY W. F. VERNER.

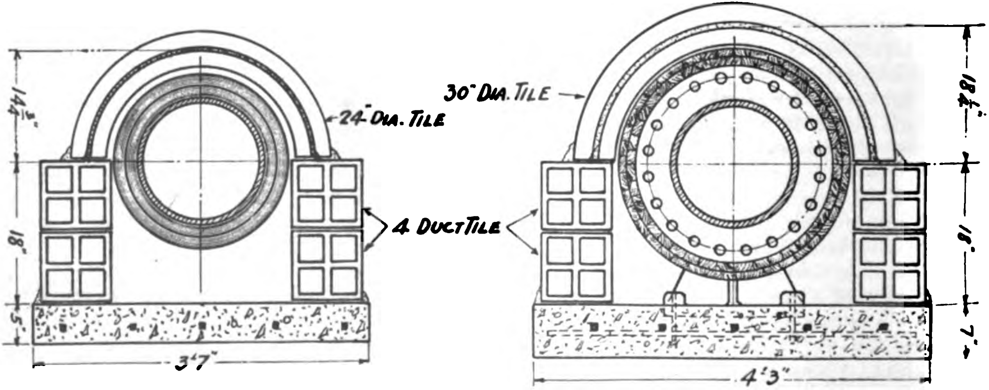
The unit prices for labor and materials given in my paper on "The Cost of Removing and Replacing Pavements" are those paid by public utility companies to the Department of Public Works of Detroit, Mich., during the early part of 1915. The department does all repaving and bills the companies for the cost of same.

The time and material quantities are averages of several years' construction, most of which was done in the business district of Detroit.

◆

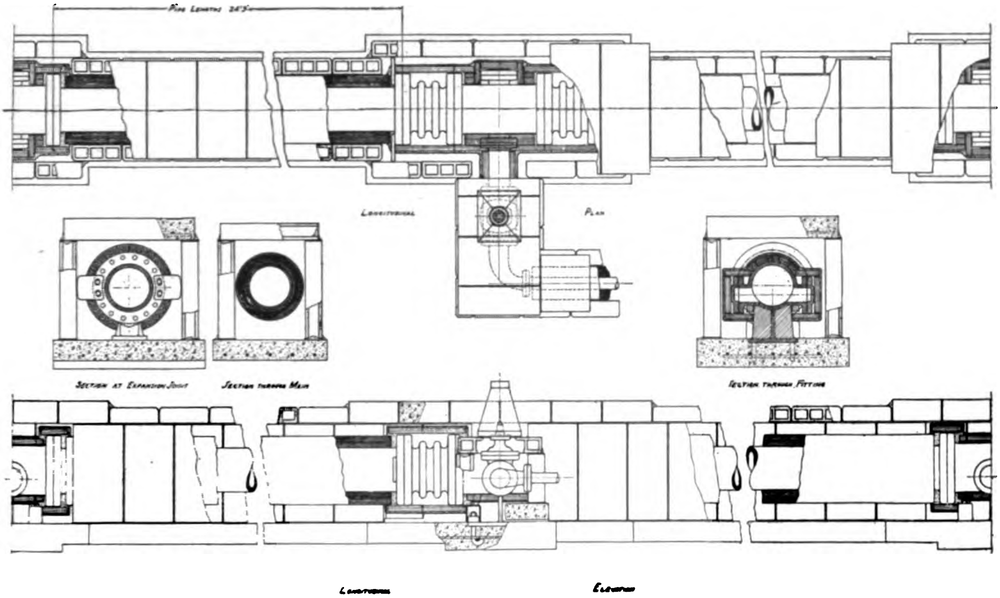
Important Extension of Central Station Steam Service in New York.

Plans for the extension of the service of the New York Steam Company in both the downtown and uptown districts of New York City, involving a total outlay of over $1,000,000, are now being carried out. The work covers a three-year programme and includes the relaying of 30,000 ft. of underground conduits on the order of the New York Public Service Commission. This relay work alone will cost approximately $500,000. The commission has charge of the construction of the New York Subway extensions and many of the steam company's mains are close to the subway excavations.

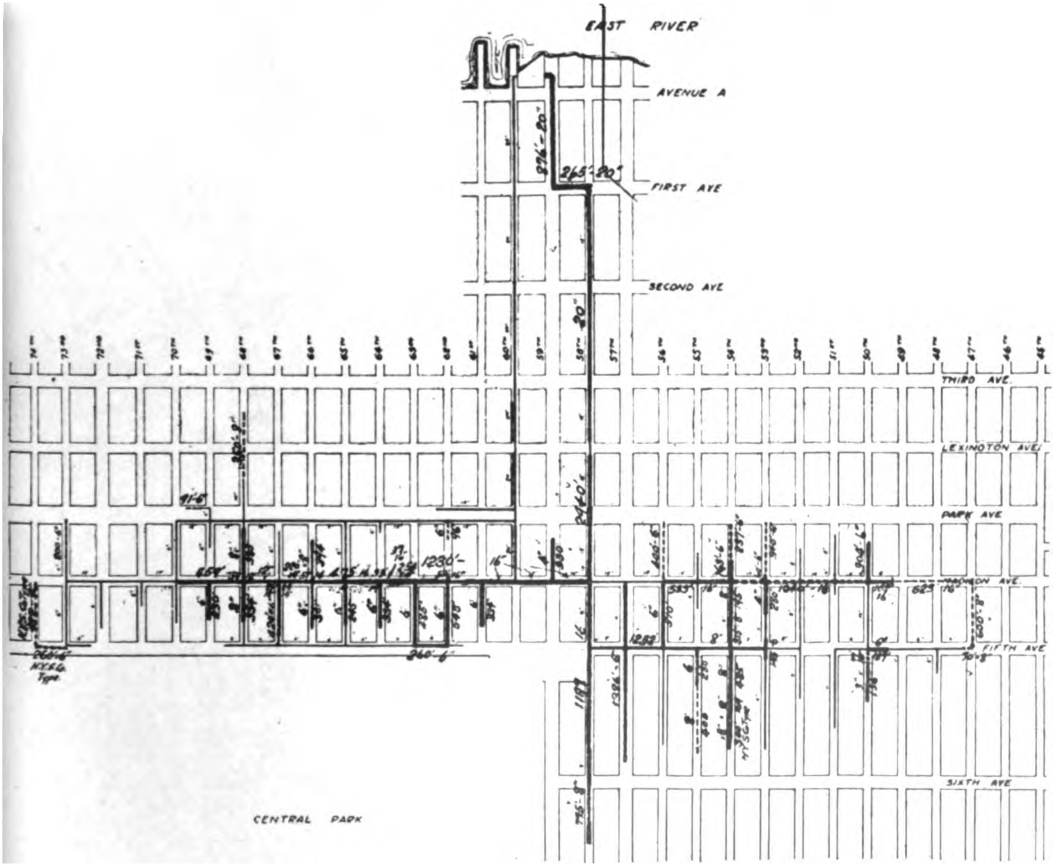


SECTION BETWEEN FITTINGS   SECTION AT FITTING

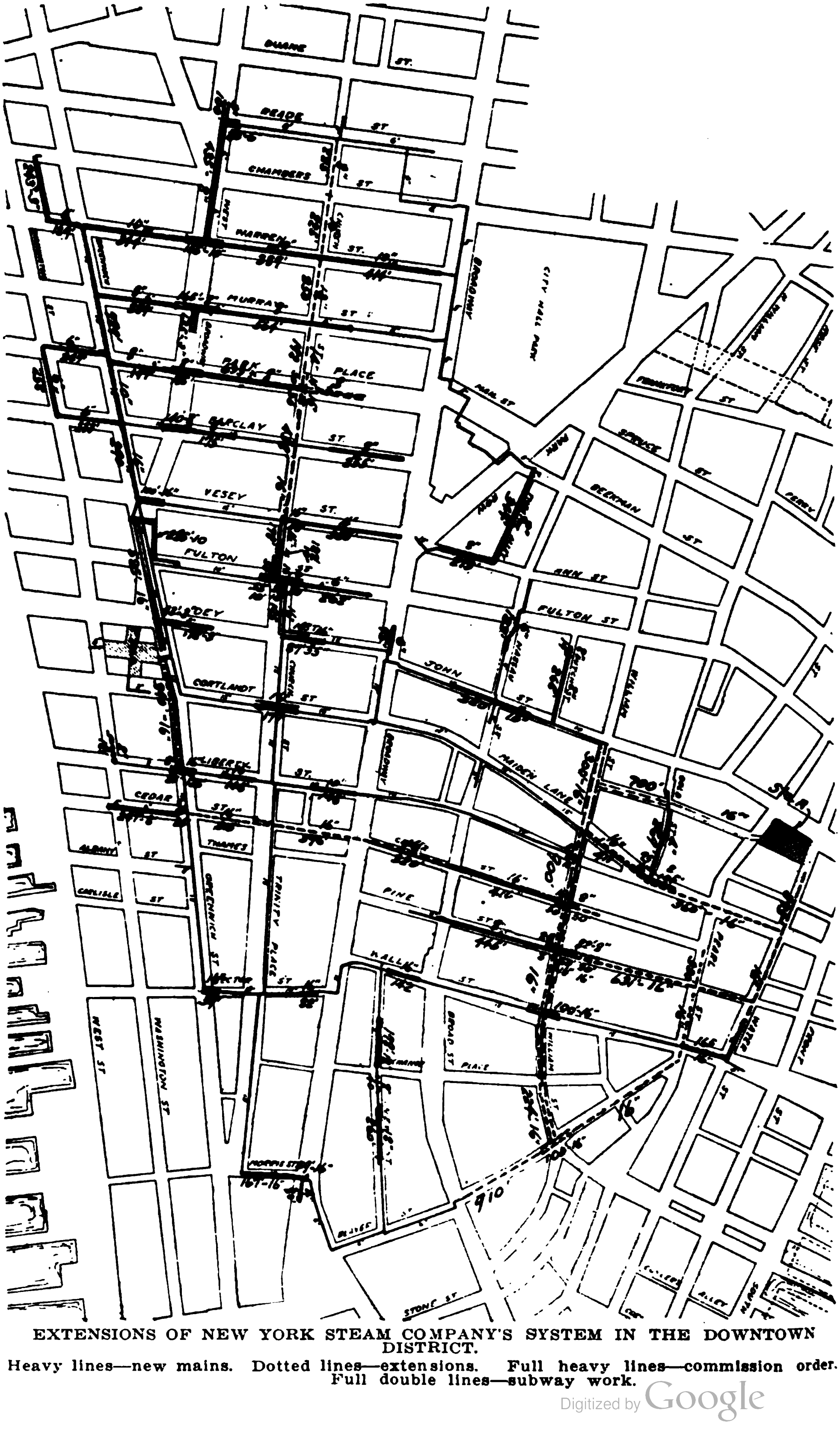
CONSTRUCTION FOR 14-IN. AND 16-IN. MAINS, NEW YORK STEAM COMPANY.



CONSTRUCTION FOR PIPE LINE 12-IN. IN DIAMETER AND UNDER.



MAP OF EXTENSIONS OF NEW YORK STEAM COMPANY'S SYSTEM IN DISTRICT J. NEW YORK.
Heavy lines—new mains. Dotted lines—extensions.

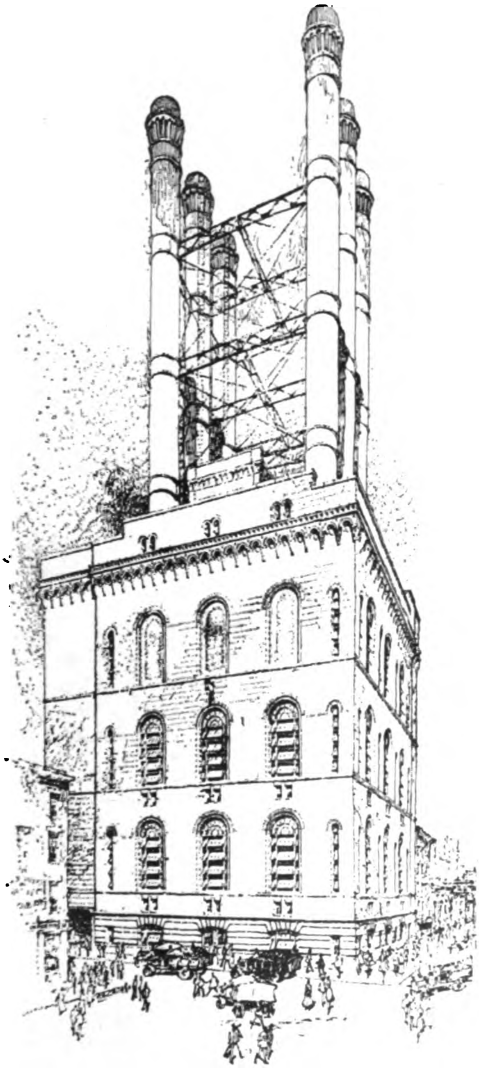


EXTENSIONS OF NEW YORK STEAM COMPANY'S SYSTEM IN THE DOWNTOWN DISTRICT.

Heavy lines—new mains. Dotted lines—extensions. Full heavy lines—commission order. Full double lines—subway work.

With the old type of insulation, some of which had been in the ground 20 years or more, it was feared that the leakage of heat from the steam pipes would damage the waterproofing of the subway.

The commission's order fell in with the company's plans for extensive changes in its system to bring it up to a proper state of efficiency and service. These plans were thereupon matured and, under the company's new management, are being actively pushed. They include the construction of a $1,500,000 power house at Burling Slip and Water Street, which will be devoted exclusively to the generation of high-pressure steam for operating power and heating equipments in the Wall Street district. The new power house will have a capacity of 20,000 H. P., and as soon as it is ready for operation, probably some time in October, 1916, the company will proceed to rehabilitate its present 18,000 H. P. plant on Dey Street.



NEW POWER HOUSE OF THE NEW YORK STEAM COMPANY AT WATER ST. AND BURLING SLIP, NEW YORK.

An interesting feature of the new power house in Burling Slip is that it is equipped with Cox stokers for burning anthracite coal. This and other features, when compared with the company's plant on Dey Street, afford an interesting commentary on the progress of modern power plant practice. The new building is 150 ft. in height and the total height to the top of the smoke stacks is 310 feet.

Fully 80% of the company's present street lines will ultimately be rebuilt, while the proposed extensions amount to approximately 20,000 ft. in the downtown district and 15,000 ft. uptown. The old construction of standard pressure fittings and screwed pipe is being replaced throughout by extra heavy fittings and welded flange pipe. The accompanying illustrations include views of the new types of conduit adopted, Fig. 2 showing the construction for pipe lines 16 in. in diameter and Fig. 3 showing the multi-cell construction used for lines of smaller diameter.

The extensions in the uptown district are equally important. In the company's 59th Street station on the East River (Station J), additional boilers are being installed in an annex to the power house and the entire boiler equipment is being converted from hand-fire to soft coal stokers. When completed, this plant will have a total of 36,700 H. P., the former horsepower being 20,000.

A general idea of the extensions of the company's lines is given in the accompanying maps. This work, as well as the construction of the new power house and the extension of Station J, is being carried out by a separate company formed for the purpose and called the Burling Engineering & Construction Co., with offices in the same building as that now occupied by the New York Steam Company, at 280 Madison Avenue. Each company occupies an entire floor in this building and the quarters have been handsomely fitted up on a scale indicating the company's increased activities.

The developments here described followed extensive changes in the management of the company last year when large Western financial interests came into control. Among the new officers, representing the interests referred to, are A. E. Duram, who was chosen president, succeeding G. C.

St. John; and C. A. Gillham, chosen vice-president, succeeding C. C. Upham. These new officers were both formerly identified with the Central Station Engineering Co., of Chicago, and later with the American District Steam Co., of North Tonawanda.

The full list of officers of the New York Steam Company is: President, A. E. Duram; vice-president, C. A. Gillham; secretary-treasurer, George S. Beith. Board of directors: A. E. Duram, C. A. Gillham, George S. Beith, Karl R. Miner, Sidney S. Wilson, A. H. Van Gorder, F. E. Pendleton, W. J. Baldwin, Jr., and A. E. Smith.

The Burling Engineering & Construction Company is organized as follows: President, T. P. Pinckard; vice-presidents, H. A. Austin and H. O. Greist; treasurer, Kenneth Stevenson; secretary, H. R. Brown.

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Taking Cinders and Dust from the Gases in Chimneys.

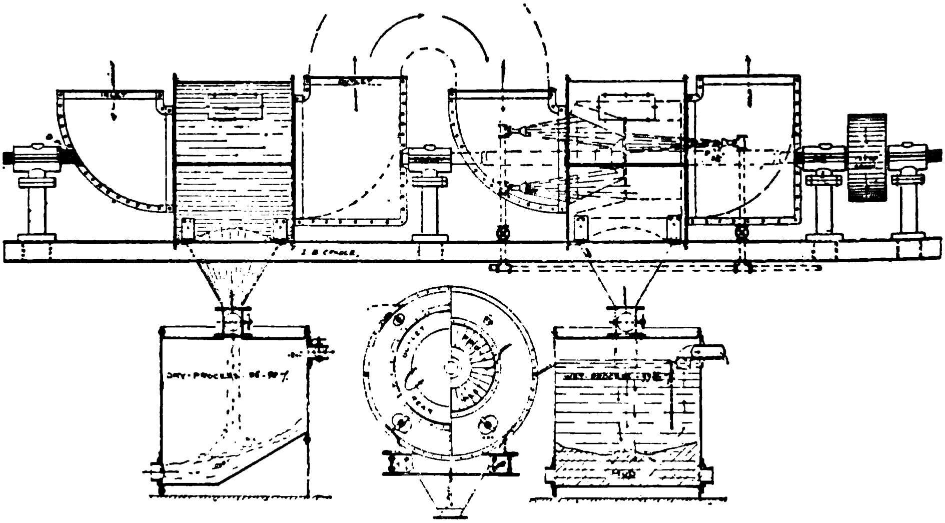
A dry method of preventing dust and cinders from being carried out of the tops of chimneys, in which use is made of centrifugal force to separate the dust from the smoke, was described by William J. Baldwin recently before the Brooklyn Engineers' Club. The apparatus was designed by Mr. Baldwin and emphasis is laid on the point that it should not be confounded with smoke prevention apparatus, nor is it designed to compete with ventilating devices or humidifiers, although the apparatus may be adapted to a variety of uses.

While performing its stated functions the apparatus is also designed to accelerate the chimney draft, when desired, and to help balance the draft.

Dust and cinder prevention have been accomplished with some success by the use of water, but too much water cools the chimney gases and destroys the draft, as well as eats away the iron flue connections and the dampers. A "rain" of water has been showered upon an apron in a closed chamber, successfully removing the cinders and dust, but the acids that form with the use of the water shower are likely to eat away the iron smoke breechings. Also, sulphuric and other acids condensed from the chimney gases will attack even cement chambers and the chimney linings.

In the design of a dry method, advantage was taken of the fact that dust will leave the air by gravity under favorable conditions. To make such an idea practicable in a machine occupying a small space, it became necessary to make centrifugal force take the place of centrifugal force. In this way the dust and cinders are forced into a closed box, but without allowing the air to follow the dust. As the dust is thrown out over a full circle of 360 degrees, it was necessary to make the dust box an annulus. It was found that when the dust was thrown through a perforated band on the inner side of the annular box, the particles would remain in the box and fall to the lower side and thence to any desirable place of disposal lower than the box.

It was also found that when the annular box revolved, the particles thrown



24-IN. TANDEM SEPARATOR DESIGNED BY WILLIAM J. BALDWIN FOR SEPARATING CINDER AND DUST FROM SMOKE.
Speed—1,150 r. p. m. Quantity—10,000 cu. ft. min. Power—20 h. p.

against its inner and perforated surface received an additional impetus and that they could not return again to the source. The box was, therefore, designed to be revolved. With this arrangement dust particles striking the box with a velocity or outward force of 100 while in the gas, receive a velocity of about 150 when they touch the perforated rotor, so that there is not only the initial projecting force to throw the particles against the screen, but an added force to keep them from returning. Once outside the perforated band, the cinders in the gas come under the influence of gravitation and fall away.

While the cinder and dust pass through the perforated band, the air or gas will not, because the outer case is closed. The perforated screen is in the path of the high velocity gases against which the air or gas strikes and changes its course, the dust particles doing the same to some extent, the effect being to give the gases an additional impulse. In actual operation some of the particles pass directly through the perforation and some lodge against the solid part of the screen, but these are forced through the next opening by the deflected air or gas.

With this machine it has been found possible to take out as much as 90 to 95% of ordinary chimney dust dry, and if water is used in the machine practically all of the dust can be removed. The machines are intended to be located between the powerhouse boilers and the chimney.

In discussing the general subject of cinder removal, Mr. Baldwin called attention to the fact that at the present time, when it is so common to run boilers at 300% or more of their rated capacity in the busy hours, it is a greater necessity than ever to intercept that part of the dust and cinders that now go up the chimney. He also pointed out that the average factory boiler chimney will take care of, say, 500 H. P. and a power house chimney may take care of 50,000 to 100,000 H. P., so that there is from 100 to 200 times as much dust per unit of area of roof or street, from the power house as from the factory chimney.

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More Publicity for Warm Air Furnaces.

Renewed efforts to extend the use of warm air furnaces were decided upon at the recent meeting of the National Warm Heating and Ventilating Association, which was held in Cleveland, June 6. President John D. Green of Detroit was re-elected, as were the other officers, including Vice-President F. T. Giblin, Utica, N. Y.; Treasurer W. G. Wise, Akron, O., and Secretary Allen W. Williams, Columbus, O. The executive committee for the coming year will be composed of John A. Howard, Dowagiac, Mich., E. P. Miller, Marshalltown, Ia., and Charles Seelbach, Cleveland, O.

In connection with the publicity campaign, it was voted to authorize a committee to collect and expend a fund for advertising on a basis of double the apportionment of last year. This would give about $50,000 to be expended in the coming year. Last year the money was devoted largely to advertising in the general magazines.

The assoiation has a membership of 56 concerns, representing, acording to President Green, 80% of .the total output of warm air furnaces in the United States.

Secretary Williams, in his report, presented some interesting trade statistics showing generally that there has been an increase during the past year in the warm air furnace industry, that the cost of goods used by the manufacturers has not changed appreciably during that time and that the cost of distribution is, if anything, a little less than it was last year. The trade prospects were generally considered to be good, although some reported "fair," but none "poor."

Professor Kenneth G. Smith, of the Iowa State College, addressed the meeting on "College Courses in Warm Air Heating and Engineering," giving details of the course on this subject at the Iowa State College. Frank K. Chew, of New York, also spoke on "Heating Low-Cost Houses."

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Current Heating and Ventilating Literature.

(Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.)*

INSTITUTION PLANTS—

Design of a Power Plant for an Institution. Charles L. Hubbard. Ills. 2200 w. N E—April, 1916. Serial, 1st part. Essential steps. 20c.

SCHOOL PLANTS—

The School Power Plant. Harold L. Alt. Ills. 2500 w. Bkbld—April, 1916. Practical examples. 40c.

VENTILATION—

Ventilation Requirements and Test Methods. E. V. Hill, with discussion. Ills.

25 pp. W S E Jl—Feb., 1916. Good practice and methods. 40c.

Indirect Heating and Ventilation. Edward H. Kearny. 5000 w. N E—April, 1916. Various systems. 20c.

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Papers Published by New York State Commission on Ventilation.

In addition to reports on the work of the New York State Commission on Ventilation which have been presented before the American Society of Heating and Ventilating Engineers, the commission has recently published the following papers in the form of reprints of articles dealing with the activities of the commission:

"The Action of Temperature and Humidity on the Working Power of Muscles and on the Sugar of the Blood," by Frederic S. Lee and Ernest L. Scott (American Journal of Physiology, May, 1916).

"The Kata Thermometer as a Measure of the Effect of Atmospheric Conditions Upon Bodily Comfort," by C.-E. A. Winslow (Science, May 19, 1916). (A detailed description of the construction and use of the Kata thermometer was published in THE HEATING AND VENTILATING MAGAZINE for September, 1915.)

"The Effect of Changes in Atmospheric Conditions Upon the Upper Respiratory Tract," by James Alexander Miller and G. H. Cocks (Transactions of the American Climatological and Clinical Association, 1915).

"A New Sampling Apparatus for the Determination of Aerial Dust," by George T. Palmer (American Journal of Public Health, January, 1916).

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Simple Directions for Measuring Humidity.

To measure humidity is not difficult. Everyone knows that evaporation takes heat or causes a cooling of the surface from which evaporation takes place. The cooling of the face by bay rum after a shave is a familiar example. The more rapid the evaporation, the greater the cooling effect. Naturally, dry air will evaporate water more rapidly than moist air, just as a dry sponge soaks up water more rapidly than a wet sponge.

We make use of this principle in measuring humidity as follows: Take this ordinary mercury thermometer and read the temperature of the room. Whirl it about on the end of a string so as to get a good average temperature. Note that this temperature, known in measuring humidity as the dry bulb temperature, is simply the room temperature.

Now let us wrap a piece of porous muslin about the bulb and wet it with water. The temperature drops at once, due to the fact that the water is evaporating. The drier the air, the faster and farther the temperature will drop. Swing the thermometer about on the end of the string so as to produce a current of air about the bulb. The temperature continues to fall but becomes stationary after a little time. This final temperature is known as the wet bulb temperature.

The difference between the wet and dry bulb temperatures is a measure of the relative humidity. The greater the difference between the two at a given temperature, the drier the air. We could calculate the relative humidity if we desired, but the practical man uses a humidity table, obtainable in the catalogues of companies manufacturing air conditioning apparatus. This simply says that for a difference of so many degrees at a given temperature the humidity is so much in per cent. Instruments, known as sling psychrometers, are used for very accurate work, but with a common thermometer used as I have shown you can obtain very fair results.

The dry bulb or room temperature, we will say, is 71° F. This thermometer, now used as a wet bulb thermometer, reads 57°. The difference is 14°. According to this table, a difference of 14° at a temperature of 71° indicates a relative humidity of 41%.

KENNETH G. SMITH.

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THE BUSINESS OUTLOOK.

VI.

By FRANK M. HUSTON.

Financial Editor of the Chicago Evening Post; Editor Rand-McNally Bankers' Monthly.

Business is forging ahead in a remarkable way. Monthly statistics relating to the volume of bank exchanges at the leading centers of the country give ample evidence of an unprecedented activity in the business world, and this applies with equal force to practically every section of the United States. According to the last available statistics, clearings show an increase over the preceding year of approximately 35.2%, and in excess of 50% over two years ago, when computed on daily averages.

There is nothing that reflects immediate improvement in the business situation, or the reverse, so quickly as bank clearings, because they represent the exchange of instruments of credit passing between banks and, when analyzed for the country at large, they reflect fairly accurately the general trend in a period of time.

The greatest menace to this country has been the excess of money, for it afforded opportunities and encouragement to more or less wild speculation. Bankers all over the country, however, have been pursuing a conservative course. They have learned important lessons from experiences in the past and have frowned on those projects that were largely speculative in their character, being fully aware that any sudden outburst of speculation was certain to be followed by an equally violent reaction.

With this in mind, and realizing that the tremendous expansion of business along legitimate lines would require an immense amount of credit, the bankers have sought to avoid the pitfalls of the past by keeping their institutions as liquid as possible, even sacrificing earnings to do this, and the wisdom of their policy is now bringing results.

One of the most reassuring features of the present situation is the widespread employment of labor. From all parts of the country comes a report of a scarcity of labor, and this means better wages, steadier employment, greater opportunities for savings and the accumulation of capital in the hands of the small business man, a thing which contributes more to general prosperity because it affords a wider and better distribution of increased buying power and helps the small merchant or retailer as well as the manufacturer.

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New Book.

Practical Sheet Metal Duct Construction, a treatise on the construction and erection of heating and ventilating ducts, by William Neubecker, has been published by *Sheet Metal*, New York. This book, it is stated, is the only one treating on construction and erection work of this character. It is an exceedingly practical manual, the text being explicit to a generous degree, while the illustrations are copious and show every important step taken in the construction of ducts, register boxes, casings for indirect radiators, ventilators, etc. The book sells for $2.00 and may be obtained through the book department of The Heating and Ventilating Magazine.

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No Summer Meeting for British Heating Engineers.

Announcement is made by the Institution of Heating and Ventilating Engineers that, owing to prevailing conditions in England at the present time, there will not be a summer meeting of the institution this year.

Application of the Steamo Air Moistener.

The accompanying illustrations, showing two general applications of the Steamo air moistener, will be of interest to those who desire to humidify by the use of steam.

Two sizes are made for application to radiators, taking steam directly from the radiator as long as the steam is turned on. This style is much used, but it is obvious that the preferable way is to take steam from the system outside of the radiator valve, so that humidification may be independent of heating. For this purpose two styles, shown in the illustrations, are more generally used.

In many cases vertical steam risers are particularly accessible; this is especially true of office buildings. In such cases the type shown in Fig. 1 is used. It connects with the riser by a stem having either a ⅜-in. or ½-in. pipe thread. On new work, where tees are set in the riser for the purpose, the ½-in. connection is used, but on old work, where it is necessary to tap the riser, the ⅜-in. size is generally used, on account of its finer thread.

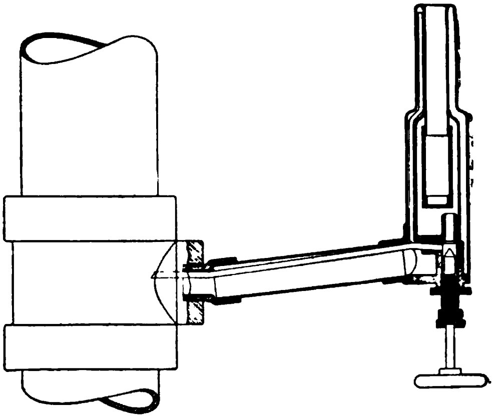


FIG. 1.—SECTIONAL VIEW OF RISER TYPE STEAMO AIR MOISTENER.

Fig. 1 shows this type in section as it screws into the tee of the riser. The air moistener proper is entirely surrounded by a steam jacket designed to prevent condensation, and to keep the silencer dry, so that no water will be discharged, and so that the device will work without noise. The stem of the moistener, which connects to the riser, besides holding the device in place, acts only as a supply for steam to and as a return for condensation from the jacket. In other respects the stem and the jacket are independent of the air moistener proper. The stem, being of ample size and pitch, allows a free return of the condensation when it is screwed directly into the riser. If, however, any intervening fittings are employed, they are sure to prevent a return of the condensation, with the result that the jacket will get cold, and the moistener will not work properly.

As shown, a small pipe along the top of the stem extends well into the riser, where the steam is sure to be dry, and where it is out of the way of interference with the condensation return from the jacket. This pipe connects with the hand valve shown at the base of the moistener. The valve is set at the amount of opening required to insure the desired steam supply.

The steam from the riser by way of the small pipe and control valve passes upward and discharges into the closed silencer jacket, surrounding the silencer, through the sides of which it penetrates to the central outlet passage and thence upward to the atmosphere. The surrounding steam jacket is readily identified as the outer casing.

The radiator moisteners are just the same in principle as the riser type except that the connecting stem is much shorter and the screw connection of the No. 1 is ⅛-in. and the No. 2 is ¼-in. pipe thread.

In those cases where the riser type is not suited to the situation, the single pipe type is usually employed, being often connected as shown by Figs. 2 and 3. Fig. 2 is an end view showing the moistener connected to the branch outside of the radiator valve by a bent pipe, although it may be made by using 45 degree ells. Fig. 3 is a front view of the same form of connection. Any other form of connection may be used as long as it conforms to the following requirements: Never use pipe or fittings of a size smaller than that which the Steamo is tapped for. Always take steam from the top of the branch, never from the bottom or side. Provide plenty of pitch so that the condensation may return against the flowing steam. Do not use long, horizontal connections.

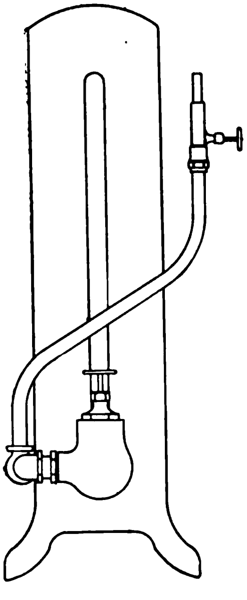


FIG. 2.—SINGLE-PIPE TYPE MOISTENER.

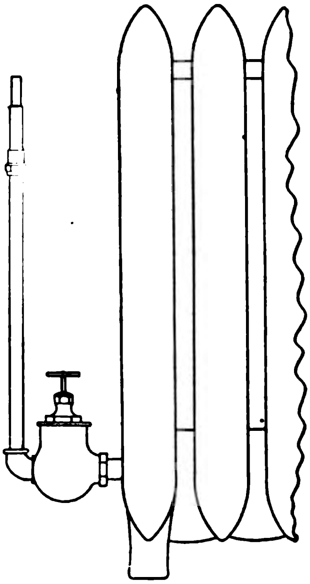


FIG. 3.—ANOTHER ARRANGEMENT OF SINGLE-PIPE TYPE MOISTENER.

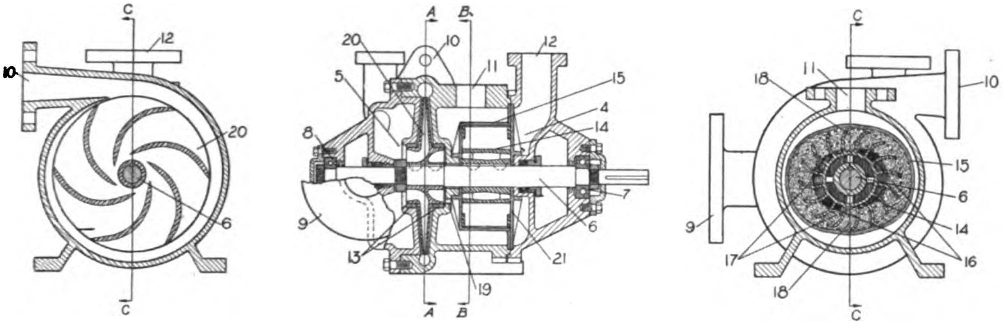
The manufacturer is the Air Moistener Co., Chicago, Ill.

◆

A New Return Line Heating Pump.

An interesting development in vacuum pumps for return line work has been made by the Nash Engineering Co., South Norwalk, Conn. The pump is a turbine proposition, running direct-connected to standard-speed electric motor. It is furnished in five sizes, suitable for handling from 3,000 to 6.500 sq. ft. of direct radiation or its equivalent, and special units are supplied to take care of the largest heating systems.

The pump is really two pumps in one, a hydro-turbine vacuum pump, and a centrifugal water pump, both contained in one casing, the impellers of each pump are on the same shaft which is supported on highest grade annular ball bearings, mounted outside of the casing. Figs. 1 and 2 show the interior construction. The air impeller (Fig. 1) is at 14 and the water impeller at 20. Section B-B is taken through



Section A-A Section C-C Section B-B

FIG. 1.—CONSTRUCTION OF NASH RETURN LINE PUMP.

the air end, and Section A-A through the centrifugal or water end.

Fig. 3 shows the arrangement of the piping. The water end of the pump is connected to the bottom of the separating tank C by the Pipe D. The air end of the pump is connected to the top of the separating tank by the pipe G. The returns come through the pipe A and the strainer B. The water is delivered through the Pipe F, direct to the boiler. The air outlet is connected to a vent by the Pipe H. A separator I is installed in this line to enable the water used for priming the air pump to be returned to the system.

Unlike other return line pumps, the water is separated before reaching the pump. This arrangement makes it possible to relieve four-fifths of the volume handled of back pressure, as the water only is delivered against the boiler pressure. The water is handled in a pump designed for water, and the air in a pump designed for air, which, it is stated, makes a higher efficiency possible than where the water and air are handled together.

For the reasons given and because of the design and workmanship, these pumps, it is claimed, require approximately one-half the horse power usually necessary for this work. Also the water end is so designed that it unloads when not handling water. In other words, the power is proportional to the condensation returned.

The air end of the pump works on a simple and ingenious principle. This part of the pump is a development of the well-known Nash hydro-turbine air compressor and vacuum pump, which has been made by the Nash Engineering Company for about seven years. Referring to the cross-section B-B, Fig. 1, the impeller 14 revolves freely in an elliptical casing 15, carrying water around with it. The water, following the casing due to centrifugal force, alternately recedes from and surges back into the impeller, twice in a revolution. As the water leaves the impeller it draws air in through ports 16 cut in the side of the casing. As soon as the blades of the impeller (now filled with air) pass the inlet ports, the air is trapped. The re-entering water now com-

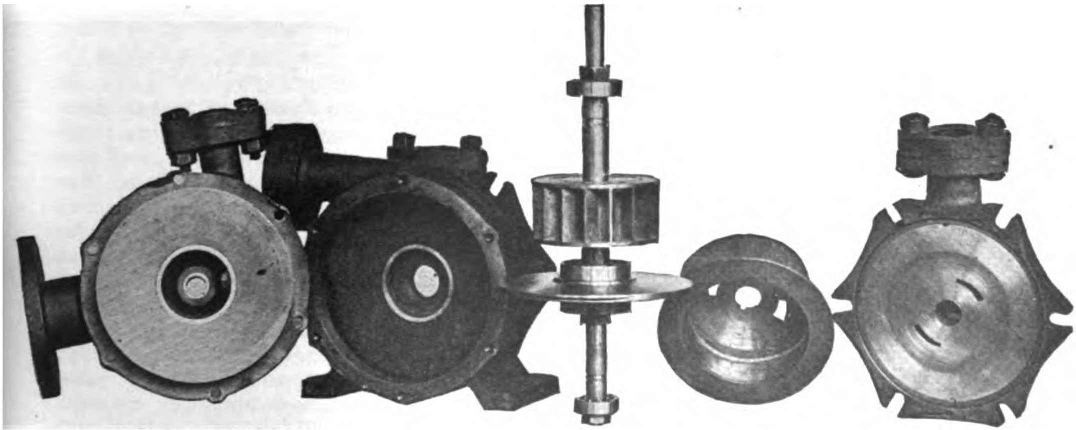


FIG. 2.—PARTS OF NASH PUMP READY FOR ASSEMBLING.

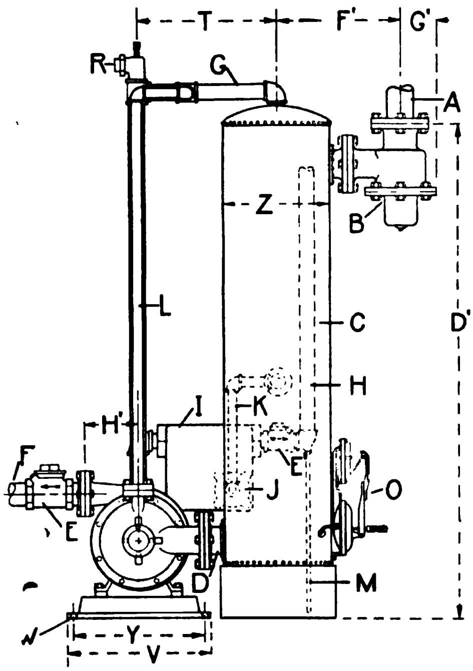


FIG 3.—PIPING CONNECTIONS TO SEPARATING TANK, PUMP AND BOILER.

A—Return riser. C—Separating tank. D—Centrifugal end of pump. F—Pipe to boiler.

presses the air and delivers it through outlet ports 17 (shown dotted because they are located in the head plate and therefore do not belong to section B-B).

As the peripheral clearance between the casing and the impeller is never less than 1/32 in., and the shaft is supported on large ball bearings (which are practically free from wear), the pump can maintain its original high efficiency indefinitely.

All valves, gears, loose blades or reciprocating parts have been eliminated, and there are no bearing adjustments to be made. The pump, it is stated, requires practically no attention in service, except two or three times in a season when the ball bearings are supplied with lubricant.

◆

Trade Literature.

Minneapolis Heat Regulators, described as the heart of the heating plant, are the subject of the latest (31st) annual catalogue of the Minneapolis Heat Regulator Co., Minneapolis, Minn. Prominent place in the catalogue is given to Model 47 one-day clock thermostat, which, when set, will change the indicator at any pre-determined hour, enabling one to have the rooms cool at night, with a resumption of the day temperature at the hour indicated. Another model (55) has an eight-day automatic time adjustment. The illustrations include views of the direct-current and alternating current motors used with this device. Size 6 x 9 in. (standard). Pp. 16.

Arco Temperature Regulation and Ideal Sylphon Heat Regulators are the subject of two recent circulars issued by the American Radiator Co., Chicago, Ill. In the Arco device the motor is spring-operated, one winding being sufficient for 60 to 75 operations. A winding indicator on the front of the motor shows the condition of the spring. They are made with one-day and eight-day clock attachments. The Sylphon devices all make use of the well-known Sylphon brass bellows. When used for air and water temperature regulation, it contains a liquid which, when heated, gives off a vapor like steam and has a powerful expansive force. The heating control is caused by the expansion and contraction of the bellows. Sylphon construction is used in the company's line of packless valves, regitherms, steam regulators, vapor regulators, water and tank regulators. Size of catalogues, 3½ x 6¼ in. Pp. 14 and 32, respectively.

Molby Down Draft Boilers is the title of a newly issued catalogue published by the Molby Boiler Co., New York, and calling attention to the fact that the company has completed an entirely new equipment for the manufacture of these boilers, including patterns, flasks and shop equipment and is prepared to turn out boilers promptly. The important features of the Molby boiler are then taken up in detail and numerous hints are given on the points to be taken into consideration in selecting a boiler, together with installation notes, with special reference to chimney requirements. Ratings are given for both steam and water boilers, including 26-in., 31-in. and 47-in. series including six or more sizes. Size, 4¼-in. x 8 in. Pp. 24.

Monash Vacuum System of Steam Heating, featuring the Monash thermostatic vacuum valve, is discussed in a well-prepared catalogue issued by the Monash Engineering Co., Chicago, Ill., sole selling agents for the Monash-Younker Co. The construction of the valve is described as very simple. The valve is nickel-plated all over, with polished top, union and nipple. The thermostatic diaphragm is made of phosphor bronze from the company's own metal formula and is rolled to dimensions found by tests to best meet the requirements of service. The thickness of the metal walls, it is stated, is approximately 125 per cent greater than in other types. The thermostatic diaphragm has been built to prevent rupture. The outer edges are rolled around a brass ring to stiffen the construction, while the center reinforcements are swaged over the walls of the diaphragm under pressure, to induce tightness and rigidity. Special emphasis is laid on the point that the diaphragm is not attached to the cover or body of the valve, but is dropped into its place in the valve between the plunger and the adjusting screw. At the same time it is impossible for it to get out of alignment. Size 6 x 9 in. (standard). Pp. 28.

Farnsworth Steam Utilities, including tilting traps and duplex boiler feeders, are treated in a new catalogue published by the Farnsworthy Mfg. Co., Boston, Mass. This system is designed to collect condensation and return it directly into the boiler. The catalogue is devoted mainly to the mechanical construction of the traps. The company states that in the Farnsworth tilting traps it has eliminated the troubles incidental to packed trunnions, with their liability to bind and leak. The oscillations of the tank on knife-edge trunnions operates a straightway Everlasting blow-off valve. Various styles of traps are produced by an ingenious arrangement of additional valves, always employing a positive valve control. The principal lines are illustrated in the catalogue, including the duplex boiler feeder, non-return trap, variable pressure trap, 3-valve lifting or pumping trap. Size 6 x 9 in. (standard).

Valve World, for June, 1916, the monthly periodical of the Crane Co., Chicago, Ill., has as its principal article a discussion of the "Open-Hearth Process" of making steel, by L. W. Spring, the company's chief chemist and metallurgist.

◆

The New Sunbeam Sectional Boilers.

Definite information is now available concerning the new line of house-heating sectional boilers, both square and round, which are being manufactured by the J. L. Mott Iron Works, New York, under the name of Sunbeam. In a catalogue, the "Fitters' Companion," just issued by the company, the new line is described in detail. Each pair of illustrations is accompanied on the opposite page by detailed information as to sizes, ratings and prices, together with a very complete statement of the basis used in establishing ratings and a statement of the factors used in the calculations by which the ratings are obtained. The company is also now manufacturing a line of plain radiators from one to five columns, as well as indirect and wall radiators, etc.

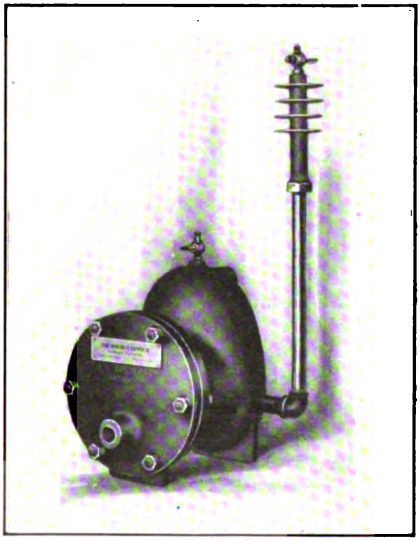
A unique feature of the catalogue is a complete essay on "How to Heat Buildings," giving all the up-to-date data on heat losses from buildings, how to adapt radiation for different conditions and how to figure radiation for different climates.

It is stated that the well-known features of the Sunray boilers, long made by this company, have been largely carried out in the new Sunbeam line. Size 4 x 7¼ in. Pp. 160.

◆

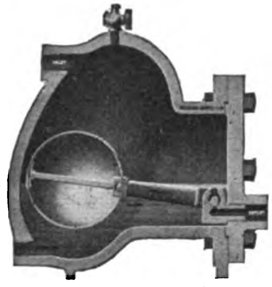
Unusual Type of Constant Flow Steam Trap.

The use of a Corliss valve in a steam trap of the constant flow type is the distinguishing feature of the Lindstrom steam trap, which is a product of the Plant Engineering & Equipment Co., 6 Church Street, New York. By the use of this arrangement of valve, it is stated that scale, grit, mud is easily kept out of the trap, nor can it pass through the valve opening when the trap is discharging. This is because the valve never draws away from its seat. At the same time the condensation has a free, unobstructed passage through the valve. By referring to the accompanying illustration, it will be noted that the trap is always water-sealed, as the condensation never entirely leaves the trap. This also has the advantage of preventing the escape of steam.



LINDSTROM TRAP FITTED WITH PENCO THERMO GAUGE.

In connection with this trap the company is furnishing a thermo-gauge accessory which will tell instantly by the sense of touch whether or not the trap is leaking. The thermo gauge is made of brass, with disc radiator and spring cock. When the trap is tight, the radiator in the gauge is filled with water and is cold, but when the trap is leaking, the radiator is always filled with steam and is very hot to the touch. With this device one or more leaky traps in a bank of traps connected to a manifold return are instantly determined.



CONSTRUCTION OF LINDSTROM TRAP.

◆

Retirement of the Howard Thermostat Co.

Announcement is made of the retirement of the Howard Thermostat Company, Oswego, N. Y., from business. The factory equipment, stock on hand, patents, good will, etc., have been purchased by the Minneapolis Heat Regulator Company, Minneapolis, Minn. The deal was negotiated by William R. Sweatt, president of the Minneapolis company. For the present, the Minneapolis company will furnish the trade with Howard devices.

The transaction marks the retirement of an old-established concern, the Howard Thermostat Company having been in business since 1893.

◆

Business Chances.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until August 1, 1916, for the construction of the U. S. Post Office at Newburyport, Mass.

Until August 2, 1916, for the remodeling of the U. S. Custom House at New Orleans, La.

Until August 7, 1916, for the mechanical equipment, except elevators, lift and lighting fixtures for the U. S. Post Office at Portland, Ore.

Until August 16, 1916, for the construction complete of the U. S. Post Office at Newark, O.

Until August 28, 1916, for the extension, remodeling, etc., of the U. S. Post Office and Custom House at Nashville, Tenn.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK AUGUST, 1916

Central Station Heating the Method of the Future

BY ARTHUR WILLIAMS.

Commercial Manager of the New York Edison Company.

(From an address before the National District Heating Association.)

We have become so used, in America, to artificial heat, supplied to us in a clean, efficient and satisfactory manner, that we do not appreciate what a modern convenience and necessity such heat, with steam as its source, has grown to be and what an essential part it has become in our daily lives.

It has always seemed to me, and I want to remark upon it in this connection, that I should rank heat as a human necessity in advance even of light, today. I make that confession because, although my entire life has been identified with the placement of electric light in the service of the local public here, yet, if the choice were left to me as to which of these two great conveniences should be eliminated, if one had to be, I should say that light would have to give way to heat; that we would even have to go back to obsolete methods of lighting, rather than to obsolete methods of obtaining heat, or of having no heat at all.

CENTRAL HEATING STATIONS FOR NEW YORK.

My second thought is that the ideal method of supplying heat in a city such as New York is that of the central station, and I am of the opinion that the day is not far distant when the small heating plant will become obsolete and we shall obtain heat exactly as we now obtain light and power, to a large extent, from a central station. My opinion is based partly upon the element of convenience, in that it is humanly possible today to turn a valve and heat a building; and humanly possible to eliminate the building of a fire and the delay that comes between the lighting of the fire and the actual obtaining of the heat in a radiator. This readiness with which heat can be instantly had when desired, together with the elements of cleanliness and sanitation resulting therefrom, constitute factors of such predominance in our modern life that I think, even if the cost of such a convenience were greater, the method has so much in its favor that in the long run it is bound to survive.

CONSUMPTION OF FUEL A FACTOR.

I am personally of the opinion that heating will be supplied from central stations eventually, because of the seemingly evident economy in the consumption of fuel. And in the supplying of heat for such buildings as we find in New York and Chicago I cannot believe that we shall ever see the substitution of water-falls for the coal pile. As time goes by, anything that tends to economy in the consumption of fuel for the attainment of a given object is bound to prevail in comparison with less efficient methods.

LABOR WILL BE CONSERVED.

Then again, there is the element of labor; and about that I want to say a word later on. If, in the long run, labor can be conserved through the securing of a given result with less labor, and especially if that result can be secured with less onerous labor, I am of the opinion that that method is going to prevail which is based largely on these two considerations, because the trend of the present century is toward results and toward means which seek to conserve human strength and human health. And the inventive effort and energies of this age are being more and more directed along those avenues of achievement that will provide means of conserving the health and strength, not of the average of all the population, but of each individual unit, man, woman or child.

I am further of the opinion that the central station method of heating will prevail, because I personally have been greatly impressed by observing central station units in other places, as well as in New York City. I have in mind such cities as Lockport, Indianapolis and others, and the plants of the New York Steam Company, in our own city.

DIFFICULTIES LIKE THOSE IN EARLY DAYS OF ELECTRICAL INDUSTRY.

I am aware that there have been difficulties at the outset of this industry, almost paralleling those that occurred in the electrical industry and which it took time to overcome. But it seems to me that the solution of these problems, which have also arisen in the heating industry, is within the grasp of the human mind; that such questions, for instance, as the efficient transmission of heat and steam from central stations to the buildings to be supplied will be satisfactorily settled, no matter how difficult their solution may appear at first; and that efficient and economical systems will be available in the near future, if they are not entirely so today.

THE ELECTRICAL AND STEAM ENGINEER SHOULD STAND SHOULDER TO SHOULDER.

If you will bear with me for a moment, I should like to approach the matter somewhat from the standpoint of the engineer who insists that the maintenance of steam service in a building is first a measure of necessity, and, secondly, that the presence of that steam service in a building justifies the coincident presence of an electric light plant. In seeking their common objectives, I hold that the electrical engineer and the steam engineer should stand shoulder to shoulder in a united effort to solve their mutual problems—that is, the rendering of a high-class, economical and relatively cheap public service. My experience, extending over a great many years, has been that the engineer of a large building uses the necessity for heat pretext for the installation of an electrical plant. The one being necessary, then he reasons that the other can be more cheaply maintained. In the process of reasoning or of accounting, he will assign, as a practical matter, an abnormally or relatively high cost to heating, leaving the difference between the alleged heating cost and the total cost of operation as that part of the total which should be charged to the electrical plant.

The next step is to take the entire electrical installation and greatly overestimate the average use, thereby reaching an entirely fictitious result as to the number of kilowatt hours required. Having reached that point in the process, the rest becomes comparatively easy, because the fictitious balance of the plant operation divided by the fictitiously high demand for electric current, gives a very low kilowatt hour resultant. Then multiplying the fictitiously high kilowatt hour consumption by the rate of the electrical company brings the electric light bill to a point where it is very much to the building engineer's satisfaction, when defending his unhappy course to his client.

THE CASE OF A FOURTH AVENUE LOFT BUILDING.

And I want to say right here, I think that process takes in practically 100% of the very large buildings in which there is any possibility of installing a private plant. I wish you would let me give you one illustration, that of a building occupying a block front on Fourth Avenue, New York City. The engineer, one of the most eminent in the country, on consulting with the architect and the owners—the owners being a large estate—said, "Now for the heating, out of a total sum of $32,000, we must allow $22,000 anyway, whether we have an electric light plant or not," and the rest seemed very easy. I was asked to attend a conference. The building contained about 5,000,000 cu. ft. I said: "We will heat that building for $10,000, $12,000 less than the estimate of the engineer." This immediately prejudiced our point of view, the executors of the estate at once assuming that the other people were right, because we were so low. I think this is so interesting a subject that I am going to relate to you more of the details. Remember, it was a store and loft building on Fourth avenue, in New York City, with electric elevators. I saw at once that they had conceived a prejudice against our figures, so I said: "I will tell you what we will do; my own estimate is $7,500 for heating the building; but I made it $10,000 because I thought that was as low as we should go; I will give you a contract that you may call upon us to heat the building at any time for $12,000," and we so contracted. My friend, Ernest Graham, of the firm of D. H. Burnham & Company of Chicago, the architects of the Equitable Building, after I had told him about this, said before I had finished my story, "Hold on, and I will tell you what I think it will cost to heat that building." And he went through a mental process for two or three minutes and finally said, "$7,500." You see there are some architects who think straight and right! We never were called on to perform that heating contract, so it is alive today.

ALL LARGE ELECTRIC LIGHT AND POWER COMPANIES SHOULD HAVE STEAM HEATING DEPARTMENTS.

I could go on and tell you instances of this kind indefinitely, because I have been through so many of them; but the point I want to make is this: there is no large electric light and power company in this country that should not have a steam heating department composed of men who thoroughly understand every line of steam heating; and no company should ever be without means at its disposal to handle just such a situation as this to which I have referred. Your profession gains nothing, gentlemen, my profession gains nothing by having in it the slightest element of misrepresentation. And it gains nothing by maintaining methods and processes which, through failure to take advantage of modern invention and modern methods of meeting the needs of the public by the combination of various services, have become obsolete and wasteful or have failed to conserve the energy of the single units in the service of the public, as I before explained.

SMALL UNITS CANNOT COMPETE WITH LARGE UNITS.

We cannot, in my judgment, operate small units, either for steam or for light and power, in competition with large units. I realize, for instance, in regard to steam that there are stepping stones perhaps to be gone over before we reach the same relative results in regard to efficiency as in electricity. But even under the best conditions you cannot today operate small units as economically as you can large units. Where the end is, in regard to size and quantity of output, I do not know, and I do not believe anybody knows.

HOW THE OPERATING ENGINEER WILL BE BENEFITTED.

Now one last point on which I speak with a great deal of feeling. The professional men who are operating private plants, engines, dynamos and boilers, and also the operating force, say that the central station men are trying to get them out of their positions. That to me, if it were true, would be the saddest part of the whole thing. To my mind there is not one man in modern industry who is not benefitted by the processes that have arisen in the past through which human labor has been conserved, and human productivity enormously enhanced. The man who is firing a boiler, the man who is running an engine, the man who is oiling the engine, every man of this kind is today benefitted by the processes whereby human labor has been minimized and the aggregate of human production increased. I can see that that process is going on in regard to these small units; so far as we are concerned, we have tried, and have always tried, to take care of labor. But as a matter of fact, I know of very few instances where a man who is running a small engine wants to take up larger team work. As a rule, he prefers to go out as an individual unit and take chances elsewhere when he has been displaced. A man in charge of a private plant, that is to say, a professional engineer, as a rule is a man of the highest grade, personally and technically; he is a man with a trade, and I have a great deal of respect for him. It is because of this that I want to say a word upon the subject.

OPERATING ENGINEERS WILL BECOME EFFICIENCY ENGINEERS.

If we could get into the minds of those men that they are too big and too worth while to work day after day and year after year in a small engine-room of a large building, with high temperature and an unsanitary office, if they would realize that they had it in them to become efficiency engineers, to take in a wider horizon of accomplishment for their employers, to take on added ability that would elevate them to higher positions where they would be relieved of the extreme attention to monotonous detail, they would see opened to them larger opportunities for usefulness and reward, and they would be introduced to a higher level of human effort and human living. If I might venture a suggestion, it would be an educational effort to point out to these men the opportunities that they have toward better management of these large structures. I think I may say that in the management of our large buildings we are practically standing today where we were standing twenty years ago. Owners do not realize that their properties need more careful management than smaller properties to make them successful and popular, and enable them to secure and maintain the good will of their tenants, who are their immediate public. To insure this, there must be efficient management from one end to the other; and the man that it pays to employ today, in the broad sense, is the man who is making the fight of his life to give a plant or large building that class of service and character of operation which is the furthest removed from obsolete methods.

Hot Water Heating for a Railroad Station in a Cold Climate

System Installed in the New Passenger Station of the Union Pacific System at Pocatello, Idaho.

When the question of heating the new passenger station for the Union Pacific system at Pocatello, Idaho, was taken up, three methods were considered and investigated. On account of cheap electric current, electric heating was thought of, along with steam and hot water heating. The engineering department finally decided to adopt hot water heating, as being more desirable from the standpoint of efficiency, economy and simplicity.

The installation was a difficult proposition from the standpoint of design for the reason that there is no basement under this building except at one end, and, consequently, all heating and plumbing piping, etc., was placed in trenches or tunnels under the floor of the building, shown in the illustration.

There are approximately 150 radiators and coils containing about 12,000 sq. ft. of surface. The power house or heating plant is located 600 ft. south of the depot building and contains 2 B. & W. boilers for furnishing steam to the steam lines in the train yard to heat coaches, etc. These boilers are in the room on the left side of the pump room.

The heating equipment, which is known as the Coogan system, is in duplicate. Each unit was designed of sufficient capacity to maintain the full guaranteed heating load at any time. The heating guarantees are based upon 10° below zero outside. During last Christmas and New Year's the coldest weather in thirty years was encountered at Pocatello. During this cold wave the thermometer registered 18° below zero on several mornings and it is a matter of record that no complaint was heard from the hundreds of employees located in this building, which is a division headquarters and contains a large number of offices on the second and third floors.

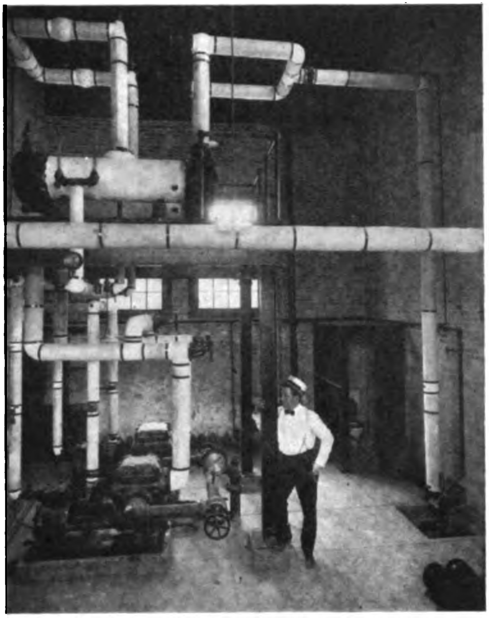
DETAILS OF EQUIPMENT.

As shown in the illustration, two Coogan convertors are set on a high platform and the circulating pumps are placed beneath them. The condensation from the convertor gravitates to a feed water heater in the boiler room, this being accomplished without the use of traps, etc. This condensation line from the bottom of the convertors is vented with large-opening air valves.

The flow and return mains between the boiler house and the depot building are carried inside of 16-in. vitrified tile and are laid on heavy wrought-iron stands without rollers of any kind, the heating lines sliding on top of the stands. In the center, between the buildings, a manhole contains two long-sleeve expansion joints. The total expansion has never exceeded 4½ in.

RESULTS OF INSULATION TESTS.

A test of the loss of heat from the two 4-in. lines in this conduit showed remarkable results. Thermometers were placed in the depot end and in the power house. With the flow water leaving the power house at 190°, there was a drop of only 1½° in the 575 ft. of actual heating line. Switching the thermometers and testing same for accuracy showed the same result. The heating lines in the conduit are not covered, but are kept in position in the center of the tile by braces placed at intervals. The dead air space all around the piping and the well-known heating insulating properties of the vitrified tile were credited with preventing loss of heat.



ARRANGEMENT OF HEATING SYSTEM FOR UNION STATION, POCATELLO.

Although this conduit is placed only 2 ft. below the surface there were no indications of melting snow along the line. This remarkably small loss of heat was most interesting to the inspectors, as the theory advanced by the engineers for not covering these heating lines in the conduit was strongly opposed.

Each radiator and each coil in the station is furnished with a Coogan distributing valve which with this system be-

UNION STATION, UNION PACIFIC RAILROAD, POCATELLO, IDAHO.

comes a permanent fitting on the radiator or coil connection and cannot be interfered with after installation. The brass disc in the Coogan valve has an orifice, designed to be of the correct area to give each radiator and each coil its share or proportion of the flowing water so that it is impossible to short-circuit any radiator or coil.

The sum total of the area of the orifices in the various valves is less than the area of the 4-in. supply main, so that it makes no difference in the circulation whether any radiator or coil is open or closed while circulation is taking place.

The radiators and coils are each connected to mains with ¾-in. connections and are provided with modulation valves so that each radiator and coil can be controlled at will. Although all connections are ¾-in. the size of the radiators and coils range in units from 9 sq. ft. to 280 sq. ft., the latter being pipe coils on walls in the baggage room, etc.

COOGAN DISTRIBUTING HOT WATER VALVE.

All connections to radiators are made from behind the radiator and branches are run to each end of the radiator so that the usual stub connections are avoided. This method of connection, it is maintained, is clean and neat and permits of unlimited expansion and contraction. All radiators have high legs.

The flow connection is made to the top of the radiator and the return connection at the bottom of the radiator at the opposite end. Each radiator and coil is provided with a swing check valve on the return side, to permit the removal of the radiator at any time without the necessity of closing down and draining the mains or branches.

Another notable feature of this installation is the fact that at no time has any steam pressure been carried on the convertors. This is due to the fact that these convertors condense all of the steam entering into same at from 10 to 20 lbs. pressure on the steam line from the boilers. During last winter's cold spells the heating results stated were obtained with 200° F. temperature in the flow main at the conduit opening in the power house.

During moderate weather the operator controls the temperature of the water by hand adjustment of the steam valves from the boiler on top of the convertors and he can raise or lower the temperature by opening these valves more or less to meet atmospheric conditions. In average weather circulation is maintained at 150° F.

A pleasing feature to the Union Pacific engineers was the simplicity of care and operation, as well as the efficiency and economy of this system.

The designing and contracting engineers are the Jesse Coogan Engineering Co., Salt Lake City.

Chart for Figuring Round and Rectangular Ventilating Ducts

BY CHARLES A. FULLER.

A number of charts have been constructed for the determination of circular air ducts, but none heretofore, to the knowledge of the writer, which would apply satisfactorily to rectangular ducts. As rectangular ducts are used almost universally on account of space conditions, the writer has endeavored to construct a chart which could be used equally for round or rectangular ducts.

The accompanying chart is based upon the assumption that a duct system should be designed with a uniform friction drop throughout the various runs. The first part of the chart is constructed for circular ducts from the standard friction formula:

$$P = \frac{K S V^2}{A} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

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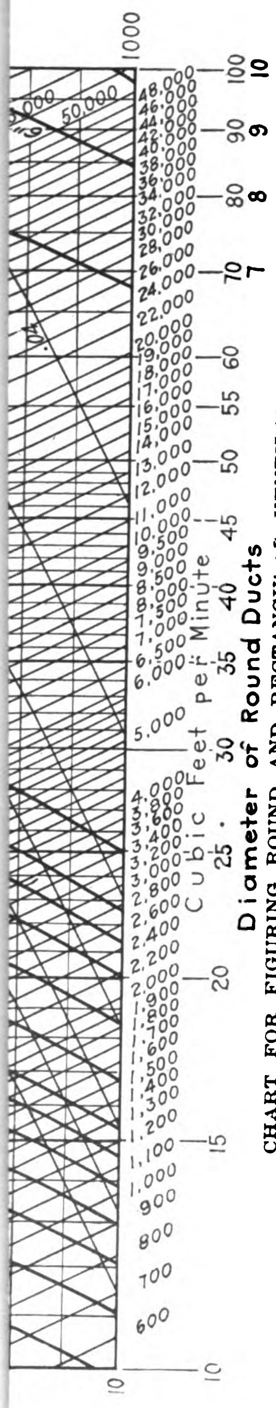

CHART FOR FIGURING ROUND AND RECTANGULAR VENTILATING DUCTS.
Designed by Charles A. Fuller.
(*Supplement to The Heating and Ventilating Magazine. Vol. XIII, No. 8, August,* 1916.)

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in which the symbols are:

P = loss of pressure or friction in inches of water gauge.
K = constant, depending upon the construction of the duct.
S = total internal rubbing surface of the duct in square feet.
V = velocity of air in feet per second.
A = area of duct in square inches.

The value of K is usually taken at 0.0002 for galvanized iron, and 0.00028 for brick or concrete ducts.

The various values from this formula are plotted on the logarithmic scale and all curves become straight lines because of the exponent of V in the second member of the equation.

The diameters of round ducts are given along the bottom of the chart from 10 in. up to 100 in. and are represented by the vertical lines. The values from 7 in. to 10 in. are also inserted along the bottom at the right hand side of the chart.

A word should be said about the way the chart is divided. The friction curves, for instance, which are found at the bottom, are repeated in the upper left-hand corner. Again, at the right hand side of the chart it will be noticed that the velocities in the round ducts, starting from the bottom, are from 1,000 ft. per minute up to 2,000 ft. per minute. The upper part shows the velocities from 300 to 1,000 ft. per minute.

DEVELOPMENT OF THE CHART FOR RECTANGULAR DUCTS.

In order to make the chart applicable to rectangular ducts, it was necessary to determine the relative carrying capacity of rectangular and circular ducts. That is, with a given quantity of air flowing through a round duct, with a certain friction loss, it is necessary, we will say, to determine the size of a rectangular duct, when one side is given, which will carry the same quanity of air with the same friction loss. The velocity in the rectangular duct will be less, due to the relatively larger rubbing surface compared with the sectional area.

In the formula for friction loss given above, V may be expressed in terms of the quanity and the area of the duct or

$$V = \frac{Q}{A}$$

in which Q represents cubic feet per minute and A represents the area of the duct in square feet. Subsituting these values in equation (1) we have

$$P = \frac{K\,S\,Q^2}{A^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Expressing A and S in terms of the diameter of a round duct and assuming 100 ft. of straight duct, equation (2) becomes

$$P = \frac{6400\,K\,Q^2}{\pi^2\,D^5} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

A similar expression may be written for a rectangular duct by substitituting a and b, the two sides of the duct, for A and S in equation (1) with 100 ft. of straight duct and the equation then becomes

$$P = \frac{200\,K\,Q^2\,(a+b)}{a^3\,b^3} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

If the two ducts are to have the same friction loss per 100 ft. of length, equation (3) and (4) are equal:

$$\frac{6400\,K\,Q^2}{\pi^2\,D^5} = \frac{200\,K\,Q^2\,(a+b)}{a^3\,b^3}$$

The two ducts are to have the same carrying capacity and to be constructed of the same material. Therefore, Q and K may be dropped from each side of the equation, which gives the following:

$$\frac{6400}{\pi^2\,D^5} = \frac{200\,(a+b)}{a^3\,b^3} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

Solving this expression for D gives:

$$D = 2\sqrt[5]{\frac{a^3 + b^3}{\pi^2\,(a+b)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Referring now to the chart, various depths of rectangular ducts have been assumed and the widths solved from formula (6) for different values of D. These values have been plotted in the form of curves by using the same curves for D obtained from equation (1).

From the chart, therefore, the dimensions of either round or rectangular ducts may be determined directly for any given quantity of air and any desired friction drop.

The velocities given at the left, however, apply only to round ducts.

EXAMPLE OF USE OF CHART.

To illustrate the application of the chart, assume that the system is to be designed on a uniform friction drop of 0.08 in. of water per 100 ft., which will apply to the average ventilating system. Assume also that the quantity of air to be delivered through a particular duct is 4000 cu. ft. per minute and that the space conditions permit of a duct 16 in. deep.

Find the intersection of the 4000 cu. ft. line with the 0.08 in. friction line. From this point, follow up vertically to the curve representing the 16-in. depth of duct. Follow thence horizontally to the left, where the proper width of the duct is found to be 37 in.

The friction drop per 100 ft. upon which to design any particular system may be determined either upon a basis of a maximum allowable velocity or upon the total friction loss of the system.

Heat Transmission Through Building Materials

Tests That Show a Higher Average Heat Loss Through Glass Than Is Generally Estimated.

By JOHN R. ALLEN.

(Read before the American Society of Heating and Ventilating Engineers, Detroit, Mich., July 19-21, 1916.)

The rate of heat transmission through building materials is a subject of fundamental importance to heating and ventilating engineers. There are many conflicting data having very little experimental foundation to establish their accuracy. About six years ago the writer constructed apparatus to determine experimentally the heat loss through building material.

This apparatus consists of a wooden box, as shown in Fig. 1. The box is 6 ft. long, 4 ft. wide and 4 ft. high on the inside. The walls are 11 in. thick and are heavily insulated with wood, air space and cork. The cross section of the insulation is shown in Fig. 2. One side of the box may be removed and in this open side the different building materials may be constructed for test purposes. The box itself is on trunnions so that it may be turned in any position, enabling the material to be tested as a floor, as a wall or as a ceiling; it is also possible, as in case of roofing material, to place the box at any angle. The box was originally placed in a room having a constant temperature so the room could be maintained at 70° F. A brine coil was placed in the box, through which cold brine could be circulated, so that the inside of the box could be maintained at a low temperature. The difficulty, however, of weighing the brine and measuring the difference of temperature where it entered and where it left the box involved so many errors that this method was abandoned.

HOW THE BOX IS HEATED.

The box has since been placed in a shed out doors, where it is free from currents of air, and the box was heated, The outside of the box was subject to ordinary atmospheric conditions while the inside of the box was maintained at uniform temperature by electric heaters. These heaters consisted of ordinary carbon filament lamps, supported from a central shaft. As the box was rotated these lamps maintained the same relative positions. The electric lamps were screened by double shields of brown paper in order to reduce the radiation of heat, and protect the electrical thermometer from radiant heat. By turning the lights on and off a uniform temperature could be maintained in the box. A recording wattmeter was used to measure the electrical energy given to the box. This electrical energy can be readily reduced to the heat equivalent.

The temperature inside of the box was determined by eight electrical thermometers placed in different parts of the box. A multiple point switch enabled the observer to read all these thermometers on one Wheatstone bridge. Before being placed in the box these thermometers were all carefully compared. A continuous recording thermometer was also used to determine the inside temperature of the box. The outside temperature of the box was determined by six mercury

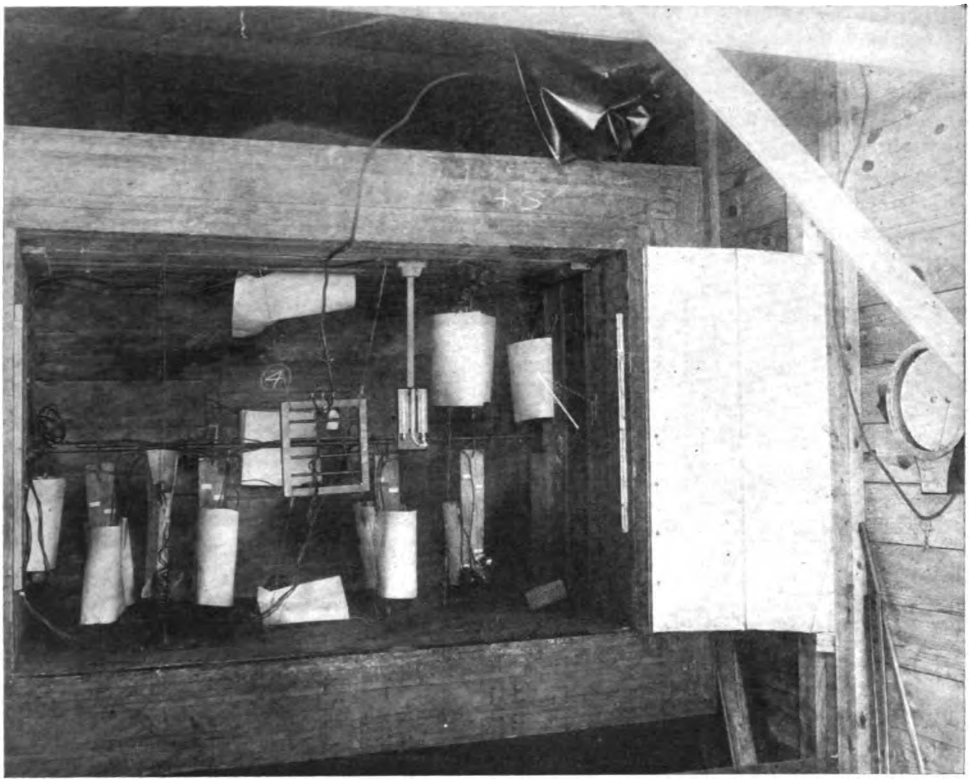


FIG. 1—INTERIOR OF TESTING BOX, SHOWING ARRANGEMENT OF THERMOMETERS AND HEATERS.

thermometers, each on a different side of the box. A continuous record of the outside temperature was also kept by a recording thermometer.

In order to determine the effect of rain on the coefficient of transmission, two rows of spray nozzles were arranged so that the material to be tested might be covered by a film of water. The effect of wind was determined by delivering air in a thin film across the surface of the material to be tested, the air velocity being produced by a blower driven by an electric motor. The air was delivered across the whole length of one side of the surface of the material to be tested. The arrangement of spray nozzles and air pipe is shown in Fig. 3.

METHOD OF TESTING

Each test was conducted with all conditions as nearly constant as possible. Particularly, care was given to maintaining a uniform difference in temperature between the inside and the outside air, and the heat input was left constant during any test or series of tests. The length of these tests was largely determined by the outside temperature, it being desirable to have a period of at least four hours of constant temperature previous to the beginning and ending of each test. Most of the tests covered a period of about 12 hours of almost constant temperature.

Other tests were made covering long periods of fluctuating outside temperature. In such cases the tests were started and finished after at least four hours of constant outside temperature, and the temperature at the beginning and the temperature at the end were the same. This avoids the necessity of correcting for the amount of heat contained in the material of which the box is constructed.

Before commencing an experiment with any given material it is necessary to determine the radiation loss from the box itself. For this test, a side constructed in the same manner as the rest of the box was placed in the open side of the box. A coefficient was determined for the outside surface of the walls, and this was applied to all the surface exposed to outside temperature. This calibration test gives a loss of 798 B.T.U. per hour per degree difference of temperature from the insulated sides of the box, when the center of the wall of the tested material is 10 in. from the face of the box. When the tested material is flush with the face of the box, the loss is 749 B.T.U. per hour per degree difference of temperature.

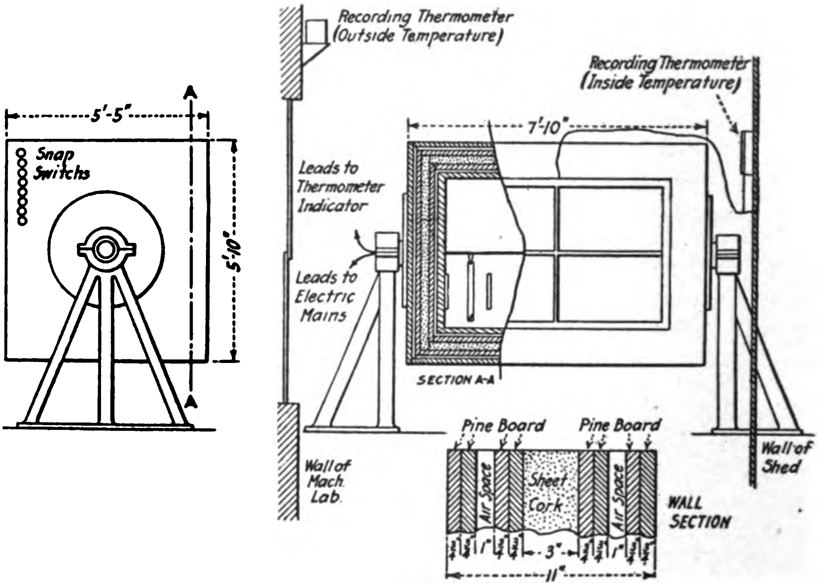


FIG. 2.—DETAILS OF CONSTRUCTION OF THE WOODEN TEST BOX.

CONDITIONS OF THE TEST

The only material that has been tested with this device, up to this time, is glass. The tests have been divided into two series. The first was to determine the coefficient *K* for glass used as a window, a floor, a horizontal roof, and a roof at an inclination of 45 deg. The second series of tests was made to determine the coefficient of heat transmission for glass in a vertical position and subject to an atmosphere without wind or rain, with a violent rain, with a violent wind, and with rain and wind.

In the first series of tests the glass was set back 10 in. from the face of the box, while in the second set of tests the glass was placed flush with the face of the box.

RESULTS.

The results of the tests appear in Tables 1, 2, 3 and 4, as follows:

Table I shows the result of the calibration test and gives the value of *K* for the insulated box;

Table II shows the results of the test for the determination of the value of *K* for the glass in different positions;

Table III shows the results for the value of *K* subject to wind and rain. The velocity of the wind was about 37 miles per hour in these tests;

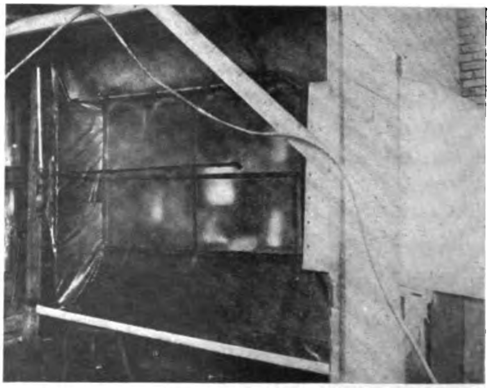
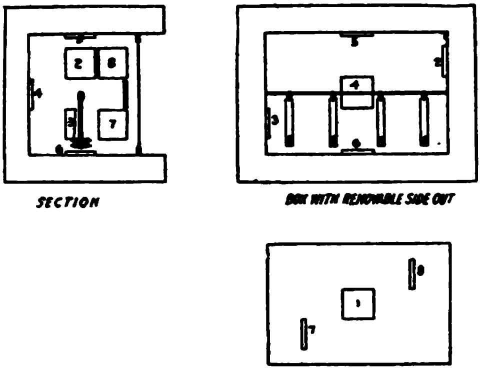


FIG. 3.—SPRAY NOZZLES AND AIR DUCT FOR PRODUCING EFFECTS OF WIND AND RAIN.



SECTION BOX WITH REMOVABLE SIDE OUT THERMOMETERS NEAR GLASS

FIG. 4.—DIAGRAM OF TEST BOX, SHOWING ARRANGEMENTS OF ELECTRIC THERMOMETERS AND HEATERS.

Table IV is a summary of the results and shows a probable limit for the value of *K* for all the tests under the various conditions.

DISCUSSION OF RESULTS.

You will note from the results shown that the heat transmitted is almost the same whether glass is used as a ceiling or as a wall, but when used as a floor there is a marked reduction in heat transmitted.

The second part of Table 4 gives us some idea of what a large effect wind and rain have upon the coefficient of heat transmission. The rain increasing the heat transmission to a greater extent than the wind alone, most authors assuming the heat transmission through glass is 1 B.T.U. per square foot per degree difference of temperature and from these experiments we see that this corresponds to a condition of dry glass with a strong wind blowing. If we add to these conditions a heavy rain, the value of the coefficient is increased about 50%.

TABLE 1. CALIBRATION TEST ON THE BOX WITH AN INSULATED WALL IN THE OPEN SIDE.

1. Test No. 17. From 9 a. m., Feb. 27, to 6 a. m., Feb. 29; duration 45 hours.
2. Average of 7 electrical thermometers inside box, deg.... 94.01
3. Average of 6 mercury thermometers outside, deg........ 17.91
4. Temperature difference, deg.... 76.10
5. Watts ....185.
6. B.T.U. per watt per hr.

$$\frac{134 \times 33000 \times 60}{778 \times 100} \ldots\ldots\ldots\ldots\ 3.411$$

7. B. T. U. Input (3.411x185).... 630.
8. B. T. U. Loss per degree difference in temperature.......... 8.2816

TABLE 2.—TESTS TO DETERMINE "K" FOR DIFFERENT POSITIONS OF THE GLASS.

Test No.	18	19	22	18	22	18	21	21	21	14	20	5	11
Position	Glass in vertical position					Glass as a ceiling				Glass as 45° skylight		Glass as a floor	
Date, 1916	3/27	3/29	5/3	5/3	5/3	2/18	4/9	4/9	4/11	2/12	4/1	1/28	2/2
Duration, hrs.	26	48	136			11½	82			9	96		
Instantaneous Read.				8 A.M.	8 P.M.			6 A.M.	10 A.M.			1½	2¼
Avg. Temp. inside	89.2	92.2	139.3	138.2	131.2	72.1	85.7	80.2	87.2	75.1	91.6	70.2	78.7
Avg. Temp. outside	40.4	44.6	56.7	45.2	50.2	14.5	40.7	33.2	41.2	13.1	42.6	20.7	18.7
Temp. diff.	48.8	47.6	82.6	93.0	81.0	57.6	45.0	47.0	46.0	62.0	49.0	49.5	60.0
Watts	384	328	566	566	566	352	310	310	310	388	312	262	386
B.t.u. input	1307	1119	1930	1930	1930	1205	1058	1058	1058	1322	1067	895	1312
B.t.u loss thru wooden sided	350	388	660	662	646	400	369	375	367	466	391	371	479
B.t.u. loss thru glass	817	730	1270	1268	1284	805	689	683	691	388	676	524	834
K	0.698	0.667	0.640	0.637	0.660	0.611	0.626	0.598	0.626	0.557	0.575	0.470	0.579
K corrected	0.480	0.577	0.612				0.525						

TABLE 3.—TESTS TO DETERMINE K FOR GLASS AS A WALL SUBJECTED TO RAIN AND WIND.

Test No.	24	24	26	26	26	26	26	28	29	29	30	31	31	32	32
Condition	No wind or water								Water		Wind	Water and Wind			
Date, 1916	5/11	5/14	5/17	5/17	5/18	5/19	5/17	5/22	5/30	6/2	6/7	6/8	6/9	6/9	6/10
Duration, hrs.	70		48				112		120		12	6		48	
Instantaneous Read.		8 A.M.		6 P.M.	6 A.M.	6 A.M.		6 A.M.		4 A.M.			6 A.M.		6 A.M.
Avg. Temp. inside	136.8	133.2	117	116.3	119.2	128.7	122.1	128.7	106.7	105.7	108.6	96.7	95.2	94.2	92.2
Avg. Temp. outside	56.7	61.2	46.2	47.2	45.2	47.2	56.4	54.2	62.9	61.2	58.5	54.7	54.2	55.8	54.2
Temp. Diff.	80.1	72.0	70.8	69.0	74.0	72.0	71.1	74.5	43.8	44.5	50.1	42.0	41.0	38.4	38.0
Watts	554	354	481	481	481	481	481	481	481	481	481	481	481	481	481
B.t.u. input	1890	1890	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
B.t.u. loss thru wood	690	615	530	517	585	539	587	566	328	332	375	314	307	288	285
B.t.u. loss thru glass	1200	1275	1110	1123	1090	1101	1308	1082	1312	1307	1265	1326	1333	1352	1355
K	0.671	0.647	0.654	0.678	0.611	0.637	0.641	0.609	1.268	1.322	1.05	1.315	1.355	1.468	1.485
K corrected	0.626		0.657				0.601								

9. Outside surface of box...... 250.
10. "K" for outside surface........ 0.03302
11. Outside surface exposed with glass set in 10 in...........241.8
12. Heat loss through outside surface exposed (241.8x0.03302 B.T.U.) 7.984
13. Outside surface exposed with glass flush 226.8
14. Heat loss through outside surface (226.8x0.03302 B.T.U.) 7.489

While a rain never occurs in zero weather it is possible that a fine snow might occur at very low temperatures. In this case the melting of the snow on the glass would give practically the effect of a wet glass at a very low outside temperature. It would seem therefore that the coefficient used for glass should be increased. The experiments show that this coefficient should be 1.48 or approximately 1,5. This would more nearly represent the maximum loss from glass than the coefficient 1, which is used at the present time.

The University of Michigan expects to carry on this line of experiments for a series of years. We shall next take up plate glass, then cement and other forms of building material.

TABLE 4. UPPER AND LOWER LIMITS, AND PROBABLE VALUE OF "K" FOR ALL TESTS.

I. Glass subject to ordinary atmospheric conditions and set in 10 inches from the face of the box.

	Limits	Probable value of "K"
Glass vertical	0.577-0.660	0.630
Glass horizontal on top	0.525-0.638	0.610
Glass inclined at 45 deg	0.557-0.575	0.575
Glass horizontal on bottom	0.47 -0.479	0.47

II. Glass flush with the part of the box and subject to wind and rain.

	Limits	Probable value of "K"
Quiet conditions	0.601-0.693	0.641
Rain, no wind	....	1.248
Rain and wind	....	1.485
Wind blowing, no rain	....	1.05

For Closer Co-operation Between the Manufacturers and Contractors of Heating Apparatus

By FREDERICK W. HERENDEEN,*

Secretary of the National Boiler and Radiator Manufacturers' Association.

I can imagine no two associations whose relationship should be closer than our two associations.

It would seem eminently fitting that the members of the Master Steam and Hot Water Fitters' Association should know just what the National Boiler and Radiator Manufacturers' Association is organized for, just what work it is doing and just what it is trying to accomplish. Therefore I will read you our constitution and by-laws. They are as follows:

CONSTITUTION AND BY-LAWS.

"*Name*—This Association shall be known as the 'National Boiler and Radiator Manufacturers' Association."

"*Object*—The object of this association shall be to promote the interests of the boiler and radiator industry along those lines wherein experience has shown that concerted rather than individual effort is necessary, and in pursuance of this object it is the purpose of the association to provide a central organization, which for the benefit of all members and the industry in general shall, as occasion may require, investigate, report and take the necessary action with respect to general questions affecting the industry.

"While obviously impossible to foresee and record these questions which may from time to time engage the activities of the association, it is apparent that diligent attention is required in connection with legislation affecting the industry, and which is being projected in ever-increasing scope and volume. It is not only essential to the interests of manufacturers of boilers and radiators, but likewise to the interests of the steam fitting trade as installers, and to the public in general as users of steam and hot water heating apparatus, that the knowledge and experience of those in the industry be readily available through a central agency for the use of those sponsoring legislation affecting the employment of such apparatus.

"Unified effort is similarly required in dealing with the matter or freight tariffs, classifications, etc., the carriers desiring and requesting that such questions affecting any given industry as a whole be presented and sponsored by some responsible agency acting for all those concerned.

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*From a paper read before the National Association of Master Steam and Hot Water Fitters.

"This association shall at no time take any action which shall violate in spirit or substance the provisions of the common law or of any present or future statute, Federal or State, dealing with monopolies, restraint of trade, the fixing of prices, the division of selling territory, the restriction of output, or other related subjects, it being distinctly understood that all such matters are beyond the purview of this association."

A year ago at your annual convention, Mr. Foster briefly told you about the activities of our association in watching State laws that were proposed, and in some cases enacted, that vitally and fundamentally had to do with your business and ours.

DANGER OF ILL-ADVISED LEGISLATION.

We have continued to carefully keep track of the laws proposed in the various States convening this past year. You may be interested in knowing that, although there were only eight State legislatures convening this past year, over forty bills were introduced affecting in one way or another your interests and our interests. Bills which, if enacted, would have compelled compulsory inspection of low pressure heating boilers, with an annual inspection fee, to be paid by the users, of from three to five dollars. Bills which, if enacted, would have rendered necessary a State licensed fireman to fire a small, low pressure heating boiler.

Many of these bills were introduced into the various legislatures by various interests, whose knowledge of the requirements of a low pressure heating boiler was extremely limited. But had the bills been enacted, as introduced, serious damage would have been caused your interests as well as ours.

Next year when all of the State legislatures convene, undoubtedly many detrimental bills will be introduced. Our association will continue to keep a watchful eye on all bills and to advise your secretary, as we have in the past, where the unreasonableness and injustice of a bill makes team work desirable.

THE A. S. M. E. BOILER CODE.

You are undoubtedly familiar with the boiler code as promulgated by the American Society of Mechanical Engineers, commonly known as the A. S. M. E. Code.

There is a society called the American Uniform Boiler Law Society, of which our association is a member, whose endeavor is to introduce this code in the various States. Our activities along this line are to see that nothing is added to the code by the various States, which would deprive the public of the sanitary and economic advantages of low pressure heating apparatus. Again, we have been aided many times by your secretary, and hope that your association and ours can work side by side on all matters which affect the public interest and that of the heating contractors and manufacturers.

CO-OPERATING WITH BOILER INSURANCE COMPANIES.

Our association has had meetings with several of the prominent boiler insurance companies, with a view to having them become better acquainted with the product which we manufacture, and which you so generally install, believing that through co-operation and a better mutual understanding, the interests of these companies as insurers of boilers, of the public as users of boilers and buyers of insurance and of the members of your association and ours, as installers and manufacturers, may all be advanced.

KEEP WATCH ON FREIGHT RATES.

You may be interested in knowing that in the United States there are four freight classification committees, whose powers are very large. Naturally, the railroad tonnage, in carrying the finished product of low-pressure steam and hot water boilers, and steam and hot water radiators, together with the tonnage of the raw material, inbound to the factories, such as coal, coke, sand and boxing lumber, is an enormous tonnage. Our association is rightfully interested in the activities of these freight committees, and very naturally oppose, as we have opposed a number of times, what we consider improper freight rates; and to insist that the product we manufacture is properly carried at proper rates.

Again your interests and ours are mutual because, as we lend our efforts along the lines of proper freight rates and conditions for the great industry of low-pressure steam and hot water heating, made more general and more generally obtainable, we have helped your interests, just as we are helping our own.

In other words, it is our earnest desire to give our attention to any and all proper subjects coming within the scope of our constitution and by-laws that have to do with the product we manufacture and sell—whether it be primarily something that interests us as manufacturers, or interests you, the trade through whom we sell our product.

RESPONSIBILITY OF CONTRACTORS TO MAKE BUSINESS PROFITABLE.

We are naturally so interested in the master steam and hot water fitters and their success that we venture to take advantage of this opportunity to dwell upon a few matters apparent to the manufacturers, without imposing too greatly on your time and good nature; and with the wish that you will accept our thoughts in the spirit they are offered, believing that benefit will accrue which will be mutually helpful.

Your organization has a duty to perform, not only for the benefit of its members but to the industry in general and to the public whom you serve. The responsibility rests upon you to make this business—the heating contracting business—one which shall yield an adequate return on capital and labor invested in it by you, for without this foundation there can be no development.

There are times when it seems difficult to appreciate the real meaning of associated effort in an industry. But our experience is that the only way in which general good can be accomplished and reasonably fair conditions maintained, is through an interchange of thought and ideas, drawn from collective funds of knowledge and experience, all of which makes for sound conclusions.

HEATING BUSINESS NOT NOW ON PROFITABLE BASIS.

We have mentioned an adequate return on brains and capital invested as one of those fundamentals on which progress in any industry must be predicated. It has been reflected to us time and again that the heating contracting business, generally speaking, is not on a profitable basis. If this be true, the question then that naturally presents itself is, "Why?" We are advancing not our own opinion, but that of those best qualified to deal with the subject when we say that primarily such a condition must be due to a failure to co-ordinate those fundamentals necessary in every business, namely, cost, overhead and profit.

COSTS NOT PROPERLY FIGURED.

I do not believe I shall be accused of exaggeration when I say that some considerable percentage of the individuals engaged in the heating contracting business are not acquainted with the essentials which must be taken into consideration when figuring costs; nor have they taken the time necessary to ascertain exactly what their overhead expense is. It is a regrettable fact that too often costs represent material and labor, and the profit, added to such a figure, is really not profit at all. The question of overhead expense is either overlooked or guessed at. And, in a very large and ever-increasing number of cases, contracts secured on this basis by the trade represent a possible loss rather than a sure profit. Such a condition is unfair to all concerned—to the contractor, the manufacturer and, less directly but just as surely—to the buying public.

COMPETITION NOT THE CAUSE OF FAILURES.

Statistics of failures, prepared by the Bradstreet Company for the year 1915, develop the fact that competitive conditions are credited with only 5.7 per cent. of the failures; on the other hand, two prominent features that make for failures are incompetence and lack of capital. In the face of this authentic report it would seem wise for us all to keep constantly before us an educational campaign that makes for a fundamental knowledge of the elements entering into business life which makes for failure or success.

VALUE OF CREDIT.

It might be in order at this time to comment briefly on the attitude of many heating contractors in connection with the question of credit. This attitude, in a large number of cases, is such as to make it appear to us as though tradition had ordained that the manufacturer furnish some considerable part of the working capital necessary for the heating contractor's business without charging any interest.

This particular feature might not be questioned so much; but, when the customer takes it for granted that this working capital, in the shape of credit, should be furnished him without his having to submit any facts or figures, that would justify the amount involved, it becomes more serious. Is it not fair to say that when a manufacturer exhibits his confidence as represented by the line of credit granted, he is entitled to reciprocity to the extent—at least—of having submitted to him a financial statement showing the existing conditions?

USE OF BANKING PRIVILEGES.

The heating contractor is not always familiar with the facilities that he, as a customer of a bank, is entitled to enjoy. He is perhaps inclined to look upon his bank solely as a convenience to be used for deposit and checking purposes. This naturally works a hardship on the manufacturers and jobbers who are compelled, on account of business conditions, to assist in capitalizing many of the trade who, by reason of their ability, integrity and character of their contracts, are logically entitled to an accommodation from their banks.

Practically all the mercantile and manufacturing interests, at certain seasons of the year, make use of their banks to tide the gap which exists between the placing of merchandise in stock and turning it into money. In our opinion it is entirely consistent, and along good business lines, for a merchant to make his bank a partner in his enterprise, and there is no reason why the heating trade should not endeavor to work along the same lines as the average mercantile establishment.

Banks must have borrowers in order to prosper, and there will be found to be a surprisingly large number of cases in which they are glad to accommodate, with reasonable loans, those customers who have occupied the position of depositors only. This is, of course, predicated on the customer's ability to demonstrate that they are worthy of confidence, and are in position to reflect the progress of their business. You should not hesitate to discuss your affairs, freely and frankly with your banker. Credit is built largely on confidence—the personal equation of the borrower is a vital factor.

CONDITIONS FOR SECURING CREDIT.

The applicant for credit at the hands of a bank should be prepared to give a concise history of his business and the conditions which make it necessary for him to seek a loan. If he is possessed of ability and integrity, and shows evidence of having made progress in his business, there is no reason why his bank should not grant favorable consideration to his request.

The heating contractor, providing he is otherwise entitled to confidence, has something substantial in the way of contracts, or accounts receivable, that are held up either through deferred payments or awaiting the completion of work by others than himself. He is not buying seasonable merchandise, subject to depreciation to put in stock, but has a market for his purchases at the time he places his order.

If the conditions surrounding his contracts are such that payments do not materialize in time for him to take care of his bills within regular trade terms and thereby maintain his credit standing with the manufacturers and jobbers, he should canvass the situation with his banker for the purpose of negotiating a loan that will help him over the gap between the time his material bills fall due and the payments come in on contracts.

It is fair to assume that bankers are favorably disposed toward the progress and promotion of commerce and industry. We feel that credit will be extended to those who prove their worthiness and who make use of same for legitimate commercial purposes. It will operate to the advantage of the industry as a whole if the trade will keep more closely in touch with and make full use of their banks.

BORROWERS LEARN TO SAFEGUARD THEIR OWN CREDITS.

In this connection, the value of the contract between the heating contractor and the banker should not be overlooked. It will serve to impress the borrower with the importance of safeguarding his own credits and cause him to look more carefully into the credit risks surrounding the work on which he figures.

The banker, by virtue of the place he occupies in the commercial world, and his knowledge of general conditions, is in position to advise his customers, and educate them along the lines of credit conservation by causing them to exercise good judgment in connection with the contracts they make. Bankers, as a general rule, are conversant with the facts surrounding the financial and mercantile interests in their community, and their advice and counsel are well worth seeking.

USE AND ABUSE OF CASH DISCOUNTS.

Before concluding these remarks, I wish to call attention to the use and abuse of cash discounts. Many of the trade do not realize the attractiveness of cash discount terms. Where the terms of sale are sixty days net, or 2 per cent. for cash in ten days, it means that if the customer will pay his bill fifty days before it matures, he is allowed the privilege of deducting 2 per cent., which is equivalent to allowing the buyer a rate of 14 2-5 per cent. per annum on the money required for prepayment. It requires but an ordinary knowledge of mathematics for the heating contractor to apply this example to his own business. Taking his volume of purchase into consideration, he will be able to prove to his own satisfaction that the question of cash discount forms one of the best foundation stones to a profitable business. This is the use of cash discounts.

The abuse consists in the customer's failure to recognize the essential features of cash discount terms. Such terms are a definite item in fixing the price at which merchandise is sold, and the premium for prepayment is too great to permit customers to interpret cash discount terms to suit themselves. It is just as unfair to expect a manufacturer to accept a settlement on which cash discount has been deducted four, five or ten days in excess of cash discount terms, as it is to arbitrarily deduct a 5 or 10 per cent. extra discount from the price quoted. Strange to relate, there are some concerns whose business principles are beyond criticism save that they habitually try to take advantage of extra time in deducting cash discount. We believe the Golden Rule should apply, and customers taking advantage of cash discount terms should see to it that settlements are made promptly and not allowed to ride an extra few days.

The Relations Between the Architect and the Master Steam Fitter

By D. KNICKERBACKER BOYD.

(From an address before the National Association of Master Steam and Hot Water Fitters.)

In the matter of direct letting of contracts, I have read all the literature on the subject, including your own "Report on the Evils of Sub-contracting." I can subscribe to the principal objections which you raise because I know that these evils have existed, but you must not condemn all general contractors. And, after all, what you are aiming to change it seems to me, is not so much the subcontracting evil as the sub-estimating principle.

I personally feel that too much stress has been laid on the sub-contracting evil without due regard to any perfectly feasible plan of controlling the estimating. Perhaps you have found this method the means of most quickly checking an abuse rather than the slower process of education.

All branches of the building trades have suffered alike from the "farming" and "huckstering" of sub-estimates and dickering with sub-contractors which is practised by some, but by no means all, general contractors. Sub-contractors who allow themselves to take part in this are equally at fault.

When work is awarded under one general contract, architects can help all the trades and very largely control the whole situation by requiring that a complete list of all sub-contractors be submitted with the estimate, the same to be subject to the approval of the architect and not to be changed without consent after the contract is awarded.

In my own practice we invariably do this, to protect all interests and insure a selection of capable men. But in the case of heating we practically always take the estimates direct, and, whenever possible, do the same with plumbing. We turn over the lowest of these to the general contractors, who estimate with the understanding that they must accept them as sub-contractors' bids if they want the contract.

This gives us the opportunity to carefully select the bidders—a most important consideration. Only the men we deem best qualified to do work of the kind and size in hand are asked, and the number limited to from three to five. This is quite sufficient. Others should not importune for the privilege and so lessen their prestige. Architects should be resolute and not allow any one to estimate who does not do the high grade of work as those selected. This will save disappointments and insure to all an equal chance on the basis of good work. Under these favorable conditions the lowest figure should prevail in the award. Under general and open competitive bidding the low estimate is often to be regarded with suspicion.

In selecting those to whom they will entrust the work, architects ought to inquire and know whether they have the respect and confidence of their associates, as well as whether they are members of their respective associations. In this way architects can help to control the situation and you can cooperate with them in many ways.

In some of the States where the separate contract law obtains, annoyance is often caused because the heating, plumbing and electrical work cannot when desired be incorporated in the general contract for State and municipal buildings. If all the contracts were separately let, and there were no general contractor, the situation would be quite different. So would it be if, after securing separate estimates on the mechanical equipment, in the manner I have indicated, the contractors for these branches of the work, upon approval as to their fitness, could become sub-contractors to the general contractor. While this would cost the owner more, it would insure a unified responsibility for the completion and term maintenance of the building, and would simplify the course of procedure throughout the work. Under the existing conditions contractors are often working at variance and the way is open for constant dispute and discussion as to interference, delay, responsibility for damage and defects.

HOW TO OBVIATE LOSSES DUE TO ESTIMATING AS SUB-CONTRACTORS.

The contention made by your committee that estimating as sub-contractors to all general contractors involves a loss to the trade is well founded, and worthy of every consideration. The difficulty would, however, be obviated if architects were required to take separate estimates just as at present, under the law referred to, but could have the option of incorporating these into the general contract under proper conditions. Your interest would be fully protected in work of this nature if the general contractor were required to furnish a bond protecting sub-contractors, as, for instance, is required on all municipal work in the city of Philadelphia, and owners and architects would be saved much annoyance and duplication of duties, clerical and supervisory.

THE SITUATION WITH REFERENCE TO THE "STANDARD DOCUMENTS."

The matter of improving the relations between architects and those entrusted with the execution of their work by no means ceased to engage the attention of architects with the discontinuance of the institute's conference committee. Work was still under way by another and larger committee of the Institute of Architects to bring about better conditions in all estimating and contractural relations in which architects, owners, contractors and others are vitally concerned.

I refer to the committee on contracts and specifications, which finally concluded its most arduous labors little more than a year ago, when, after serious and countless conferences with representatives of the National Association of Builders', exchanges and many other interested bodies, the second edition of the

"Standard Documents of the Institute" was issued.

These embrace four papers: "Form of Agreement and General Conditions of the Contract," "Bond of Suretyship," "Form of Sub-Contract," "Letter of Acceptance of Sub-Contractor's Proposal." They cover as fully as is possible the points formerly raised as to the relations of the architect to all parties in interest and the relations of these parties one to the other, including all contractors, subcontractors and the owner.

Desiring to fortify my position on this occasion with the views of other architects, I wrote several of my friends in different cities, asking for suggestions.

Among the replies received was one from W. Stanley Parker, of Boston, whose great service in connection with the work of the committee to which I have just referred, to the profession of architecture, and all interests allied with it, has everywhere been recognized.

ATTITUDE OF NEW YORK CONTRACTORS TOWARD "STANDARD DOCUMENTS."

The letter has such an important bearing on our relations that I am going to read it to you, and I earnestly hope that it may result in furthering your cooperation. He said:

"Roughly, the situation is this: The men in New York who are members of the National Association are also members of the Building Trades Employers' Association in New York. The committee of the Employers' Association has not approved the documents, and some of the steam fitters in New York seem to agree with objections that the New York Employers' Association have made. The National Association of Master Steam Fitters, however, prior to this action in New York, did approve the documents. An effort has been made to get the National association to withdraw its approval, but this action has not been taken. The National association, however, did fail to approve the revised subcontract form on account of the general situation. I have been all over the situation with one of the men in New York who, though not on the committee there, has voiced, as I understand it, the general points of opposition that they find.

"The principal objection seems to be that the documents are too long. They seem to fail to appreciate that the value of a standard document is not in its brevity, but its inclusiveness in regard to all of the most general conditions existing in a contract. They seem to feel it is a detriment to have some conditions included which rarely, if ever, occur in their particular work. The fact that the meaning of the standard clauses can be made clear by expert advice, and that they can readily learn what clauses apply to them and what do not, does not seem to appeal to them as being vastly superior to varying general conditions in which they must study, each time, the particular clauses and in regard to which they really should have expert advice of a lawyer each time.

"They also object to the liability insurance arrangement, but apparently because it costs the owner more. All we want and all we were trying to get was complete protection for the owner at the least expense. If we have not succeeded in doing this, subsequent editions will doubtless change the wording. But additional expense to the owner is no justification for refusal to approve the documents.

They also seem to think that the documents are available for application only to general contracts. They fail to see the intended and actual adaptability of the documents to *any* contract, and a heating contract practically always has sub-contracts involved in it, and so is in effect a general contract itself; the form, therefore, applies to their work as direct contractors, if their work is so executed. Doubtless in connection with a heating contract, or electric contract, or a plumbing contract, additional clauses would be needed, as in the case of nearly every building contract, and conceivably some clauses might be entirely crossed out. The fundamental provisions, however, apply. This they do not seem to appreciate.

"They object to what they conceive to be some statements that limit the architect in being the agent of the owner, and feel, apparently, that all provisions of the contract in which the architect is assumed definitely or by inference *not* to be the agent of the owner are objectionable. They fail to appreciate that for the purpose of *carrying on* the contract *as agreed upon,* the architect is definitely accredited the agent of the owner for certain specific purposes, but that for purposes of *changing the contract* his agency is properly limited, as every owner would naturally insist.

"There also seems to be objection to the fact that it is possible to make changes in the Standard Form, and that changes are even anticipated. They seem to feel that if a Standard Form can be changed it loses its value as a Standard Form. This, of course, appears on the face of it, to us, to be unreasonable, since no standard form will ever be developed that will not be subject to changes to fit individual conditions. Having, however, a complete and full Standard Form, it assists the contractor to observe readily points in which changes are made, the balance of the document being familiar to him without study in each particular case."

CONTRACTORS SHOULD NOT PAY FOR BLUEPRINTS IN ESTIMATING.

I feel that it is quite right and only proper that, except in the case perhaps of advertised work, contractors should not be required to pay for blueprints for estimating purpose. Heating contractors should also retain one set for their files and records. They are doing their full share in bearing the cost of estimating, which under out present system is but a contribution to our enormous national waste and a factor in the high cost of building. It has been computed that there is spent in this country each year for the privilege of estimating the sum of over $85,000,000, more than one-half of which, on a conservative basis, could be saved if efficient methods along the lines of the so-termed "quantity survey system" were generally adopted.

Instead of hopefully waiting for proper methods of estimating to be evolved, let us do our share now in improving them in every way possible. Architects can help greatly in conserving waste of money and human energy in the heating field alone if they will do some very simple things, which I suggest that you can call upon them to do. Some of these *are* now being done by those architects whose first thought is real service to their employers—the clients. One of these is the preparation of clear and complete drawings and precise specifications which lessen the time and risks contractors take in estimating and which convey to them the assurance that they will not, if they secure the contract, be expected to make up for shortcomings of the architect.

I have seen some architects' drawings without figures outside or inside of the plans, and have read some specifications almost as brief as this: "Heat all portions of the building to 70° in zero weather and guarantee these results." Here we have steam-fitters, say twenty to thirty, if under the sub-contractor evil, spending their time scaling off every office or room or enclosed area, when all this time could be saved if one draftsman in an architect's office had taken the time necessary to do this work once,—and properly.

In that large number of every-day cases where no consulting engineer is employed, and where you are expected to do your own calculating and engineering, and assume all responsibility for results, —only to be beaten out, if you have figured even conservatively, by some one not so scrupulous, intelligent or careful,— why not refuse to estimate until you are furnished with a reasonable amount of data upon which to base your estimate?

I would urge you, individually and collectively, assuming that you are willing to estimate under these conditions, to insist upon certain basic requirements as a precedent to estimating. Architects can help you greatly if they will become accustomed to putting on every plan both dimensions of each enclosed space,—perhaps even to computing either the area or the cubical contents of each enclosure,— moreover the addition of figures to indicate the area of window and outside door openings would in many cases save much time and handling of prints to refer back and forth from plans to elevations and sections. Can you not take this up and perhaps consider symbols for drawings?

And in the matter of incomplete and indefinite specifications or of those equally as bad, imposing conditions or guarantees impossible to provide,—even if they have been prepared merely in accordance with the routine of an antiquated custom,—why not return them to the architect or the engineer responsible for them and frankly state your reasons for not estimating? Be courageous and do this for the good of the cause!

Obviously the architect who makes every heating contractor perform gratuitous calculating and engineering saves himself time, labor and cost, and transfers these not to one but to a large number of heating contractors—and, eventually, to the owners.

And yet one of the singular factors in this condition of affairs is that the trouble often begins with the owners, who too often do not select their architects on the basis of competency and integrity. After allowing for the younger and inexperienced men who are selected on the basis of friendship or otherwise and should be given every practical assistance possible by associations of their fellows and of others in the crafts the facts are that many architects who render full and proper services are the ones who charge a greater fee than those who do not, or rather, I should say, those who do *not* render or do not *expect* to render the nicer and fairer and, in the end, the more economical service, do not charge the owner as much as those architects who do. Unfortunately some owners give too much consideration to the question of fee in selecting their architects and do not always discriminate between the kinds of service, where the recollection of the quality will remain long after the fee is forgotten. You heating men have the same thing to contend with, so you know all about it, but the owners do not discover their mistake until it is too late.

Of course, for all work of any size, for power plants, and mechanical equipment and for work of a specialized nature, it is to be presumed that the services of a competent engineer have been engaged and the drawings and specifications prepared with accuracy and precision. Presumably such a man will be a member ofThe American Society of Heating and Ventilating Engineers. If not, he ought to be.

VALUE OF HIGH-GRADE MEMBERSHIP FOR REFERENCE PURPOSES.

In passing I wish to lay stress on this matter of membership, for it applies to your own association as well. All the good men in your calling should invariably be included in your membership. Only such should be properly qualified to enjoy the privileges of your association. Then it will be pertinent on the part of architects and owners considering the awarding of a contract to inquire if the contractor about to be chosen is a member of the association, and if not, why not? Not being a member should be attributed either to a lack of eligibility or to a lack of sensitiveness to his responsibilities, for all good men should delight in assisting organizations of their fellow craftsmen, not for what good the association may do them, but for what good they may do the association.

Your association through its members and committees has already done much to simplify heating practice. This ought greatly to be appreciated by the trade in general, especially by the younger men, who have thus benefited by the results of your experience. You have in this way, also, rendered an assistance to architects and performed services to the owners and occupants of buildings perhaps unbeknown to them.

In addition to what you have done in perfecting certain practices in piping, and in standardizing flanges, couplings, and threads, etc., can you not further co-operate with The American Society of Heating and Ventilating Engineers and with the American Society of Mechanical Engineers and manufacturers of apparatus, in developing a standard or uniform basis of rating for boilers and domestic water heating apparatus, etc.? I know you have been working on this, or I have read of it in your 1914 proceedings, but can we not look for a definite pronouncement and the publishing of the results?

UNIFORM RADIATION FORMULA RECOMMENDED.

Can you not in co-operation with the same society work on developing a basic formula or officially approving one of those in existence for computing the amount of radiation recommended in proportion to cubical contents, to outside wall area (for different kinds of wells) and different exposures, to window and door openings, etc., and make this available to all architects for instant reference?

Such a formula, if not actually used, as it should be, by those architects who do not employ an engineer for some of their everyday problems, could at least be referred to in their specifications. Then, instead of calling for the building to be heated according to the varying individual judgment of each contractor estimating, these architects could refer to such a formula, as providing the minimum installation allowed. This would undoubtedly be a great improvement over the indefinite methods now obtaining and would provide equable conditions of estimating so far as capacity of apparatus and amount of radiation is concerned. If any estimate received appeared either too low in cost or deficient in quantities, such a formula would afford any architect an opportunity to check up for comparison with other estimates.

Of course, preferably, it should be used as the basis of his own calculations to be definitely stated before estimates are asked, and, if so used, I cannot see how it would interfere with the occupation of heating engineers, which is one of the arguments that might be advanced against it. Presumably it would only be used by those architects who would not in any case have employed an engineer for that particular work.

This is a suggestion which I wish you seriously to consider, for I believe it would greatly facilitate common practice in steam fitting, just as the piping of buildings for gas will be facilitated by the basic piping schedule recently adopted by the National Commercial Gas Association.

Of course this basic formula would not alone be sufficient to insure absolute equality of conditions in estimating. There are other matters to be considered, such as a general description or outline specifications or requirements for the ordinary run of work, which, it seems to me, could well be drawn up by your association. This would, of course, not apply to sizes of pipes, which in your case I appreciate are variable, but should be in the form of suggestions to architects as a basis for their specifications to provide truly competitive conditions of estimating, as to whether pipes are to be exposed or to be encased in walls or partitions, as to chasing and covering of same, as to valving and draining raisers in hot water installations, the height of radiators, whether under sills, or seats or not, and so forth, in simple work and on up into air lines, returns and other important principles in larger work.

And then there is the matter of sectional covering and banding on lateral runs, plastic covering on flanges, couplings and fittings, and on the heating apparatus itself,—surely some standards of practice could be developed which would greatly aid in establishing a uniform basis of estimating.

USE OF NAMES AND BRANDS IN SPECIFICATIONS FAVORED.

While we are speaking on the subject of clarity, why not let us co-operate to get rid of words in specifications which say, but do not mean, "very best quality" and the "or equal," in favor of calling for the brands, thickness and weight of pipes and for the various other products by the several names which will be acceptable?

More and more frequently a distinction is being made as to quality in materials of building construction and stronger encouragement is being given to those producers who, in spite of rigid competition, adhere to their standards of manufacture and make names for themselves under established brands.

Accounting Under Municipal and Private Ownership.

The discussion of the advantages of municipally-owned public utilities, such as central station heating plants, includes the following adverse argument which is going the rounds of the daily papers:

Let every man who is tempted to accept the argument of government-ownership advocates remember this: When the government computes its expenses of operation it omits many items of actual expense, particularly of the character of what may be called "overhead charges." For instance, in our postal service, the Post Office Department does not charge itself with the rental value of public buildings it occupies, nor with the expense of lighting, heating and up-keep of such buildings. A department having charge of any public service naturally desires to make a good showing in its annual statements, so many of these items are not definitely and specifically included in the expense accounts. A private concern cannot run a business on any such plan, and neither should the government.

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IN a carefully-planned effort to increase the value of engineering meetings to those in attendance, new methods are coming into use which are gradually changing the character of these gatherings. They are becoming more sociable without, however, sacrificing their professional character. It goes without saying that an engineering convention should be so conducted that every valuable item of information contained in the papers or discussions should be brought to the notice of those interested. Yet it is often the case that a general discussion will fail to bring out the vital points, sometimes because of lack of time due to a diverting discussion of other points, but more often because of diffidence or disinclination on the part of the men having the desired data. It has been found, for instance, that less than 10% of the men in attendance at a convention take part in the discussions, while the outside attractions during the sessions themselves are apt to curtail the attendance, in reality raising this percentage appreciably.

The time-honored method of conducting a technical meeting consists, briefly, in the reading of papers and reports, followed in each case, by general discussion. This, perhaps, will always be necessary, but the modern tendency is to vary such sessions with scheduled attractions, usually of a semi-engineering nature, so arranged as to insure a maximum attendance, and, at the same time, afford an opportunity for sociability and personal talks that is wholly lacking in the more formal sessions.

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A TYPICAL instance of this feature was carried out at the recent meeting of the heating engineers in Detroit. A whole day was given over to a trip to the University of Michigan, the programme calling for two engineering sessions at the university, in addition to inspection trips and entertainment features. In the first place, practically every member of the convention was present and kept with the party throughout the day. Then, on the way down and back and during the tour of inspection opportunities arose for personal chats every time the party shifted. Incidentally, in this particular case, the reading and discussion of two of the papers, containing reports of tests, were made especially interesting in coming directly after an inspection of the testing apparatus itself, which was in operation at the time at the university.

It is difficult to think of a more effective method of interesting a convention body and at the same time carrying out the purpose of the meeting. In fact, with so many technical papers printed not only in advance, but often in magazine form, it may be doubted whether they will continue to be presented at engineering meetings by more than title and perhaps a brief synopsis, leaving most of the time open for what might be termed "engineering diversions."

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Mid-Summer Meeting, Detroit, Mich., July 19-21, 1916

New ideas in conducting an engineering convention were carried out with marked success at the semi-annual meeting of the American Society of Heating and Ventilating Engineers, which was held in Detroit, Mich., July 19-21, 1916.

The recently - organized Michigan Chapter, which was the host on this occasion, lived up to its enviable reputation as one of the liveliest chapters in the society. After laying out an ambitious programme for the meeting itself and in the way of entertainment features, the chapter proceeded to carry it through with a degree of enthusiasm and "pep" that made every moment of the meeting interesting and enjoyable. It was easily the society's most successful summer meeting.

In the first place, an entire day was given up to a visit to the University of Michigan, the convention party being taken the 40 miles to Ann Arbor and back in special automobiles. Here the programme called for two engineering sessions, in addition to an inspection of the university's testing equipment and power plant, and a luncheon and organ recital thrown in.

HARRY M. HART.
President of the American Society of Heating and Ventilating Engineers.

This visit and session were the novel features of the meeting. They were carried out practically on schedule time and afforded an opportunity for sociability and good-fellowship that assured their success long before the day was over.

Before the meeting came to an end a rising vote of thanks was given to Professor John R. Allen, of the university, for the courtesies extended the society at Ann Arbor and this was followed on the closing day of the meeting, by an equally hearty vote of thanks to the Michigan Chapter for the delightful hospitality it had displayed.

Always a charming convention city, Detroit did its best throughout the convention, although the weather left no doubts in anyone's mind that it was summer time and July. The boat ride, which came on the second night, was taken under ideal conditions.

Morning Session, July 19.

President Harry M. Hart called the meeting to order in the assembly room of the Hotel Statler. He introduced Mr. Lee of the corporation counsel's office, who extended a welcome on behalf of Mayor Marx. He paid a tribute to

Secretary William F. McDonald of the Michigan Chapter, who has been appointed a member of the local building commission by Mayor Marx. This commission is revising the building code of Detroit, including not only the heating and ventilating, but construction features as well.

President Hart responded to the Mayor's welcome. He urged the extension of local chapters, declaring that the society should have at least ten or fifteen such chapters, instead of five as at present. He also suggested the appointment of "local secretaries" to represent the society in cities where no local chapters exist, with the idea of developing a chapter sentiment in such localities.

President Hart said that he looked forward to the time when the Journal of the society would become a monthly publication and he paid a tribute to the society's publication committee for the Journal's fine appearance. Regarding the advertising policy of the Journal, President Hart declared it as his opinion that the society should not attempt to make money through the Journal's advertising patronage, but that the income should be sufficient to pay the expense of publication.

ADDRESS BY WILLIAM J. BALDWIN.

Before proceeding to the regular business the chair announced that one of the honorary members of the society, William J. Baldwin, of New York, was present, and he called on Mr. Baldwin to address the meeting.

Mr. Baldwin told the convention that his first errand on arriving in Detroit was to visit the Moffat Building, which, he stated, was the second building in Detroit to be equipped with a steam heating and power plant. This plant was installed under his direction. The original elevators are still in use, although the passenger elevators are now driven by hydraulic power in place of the original Otis steam engines.

Mr. Baldwin said he was bewildered by the changes that had taken place in Detroit since his last visit to the city some thirty years since.

After his work in installing the Moffat Building plant, Mr. Baldwin remained in Detroit for several years as superintendent of the Detroit Novelty works. In Detroit, he said, was manufactured the first cast-iron hot water radiator. It was made with rubber grummets, connecting the upper part of the sections. The lower parts were of "screw nipple" construction. This unit was known as the Detroit radiator and was the pioneer product of the American Radiator Co. J. B. Dyer of Detroit, was the inceptor of this type, which, in general appearance is similar to that in general use today.

CHAPTER REPORTS.

Chapter reports were then presented from the Illinois, Michigan, New York, Ohio and Eastern Pennsylvania chapters, detailing their activities during the past year.

REPORT ON ENGINEERING CO-OPERATION.

A special report was presented by John F. Hale, who was the society's representative on the conference on engineering co-operation held by the various engineering bodies in Chicago last winter. This report was published in THE HEATING AND VENTILATING MAGAZINE for May and June.

The idea of the conference was to promote co-operation among engineers throughout the country to improve their status. A sub-committee was appointed to work up the ideas presented at the conference, to be acted on at a later meeting. Mr. Hale stated that it was possible a new organization would be formed with its membership drawn from all the engineering societies in the United States. He urged the society's continued interest in the project. It was voted to refer the matter to the council of the society, urging its favorable consideration.

An important paper was then presented by the **Committee on the Best Position** for a Radiator in a Room, W. F. Verner, chairman. The report brought out the interesting point that the best position of a radiator, from the standpoint of efficiency, is in the center of the room. That is, in this location more B.T.U. are secured per square foot per degree difference between the steam in the radiator and the average temperature of the room than when the radiator is in any other position.

HEATING AND VENTILATING ENGINEERS AT DETROIT MEETING, JULY 19-21, 1916.

Mr. Baldwin said that whether or not a radiator away from the outside wall showed greater efficiency, the fact remained that a radiator under the windows was necessary to counteract the movement of cold air across the floor.

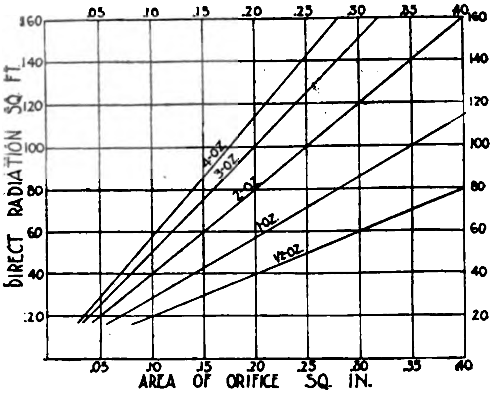
Mr. Donnelly said it was necessary to define what is meant by "best position," because the efficiency of a radiator and the maintenance of comfortable room temperatures were two different propositions, and while a location away from the window might give better efficiency it would not necessarily result in more uniform or more comfortable room temperatures.

John F. Hale stated that as he understood the report it was the purpose of the committee to show what could be done in case of necessity due to the location of furniture, etc.

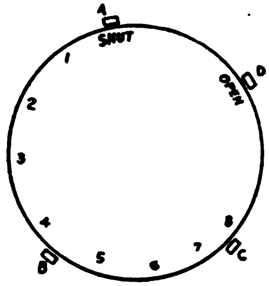
At the close of the discussion the convention photograph was taken near the main entrance of the hotel.

Afternoon Session, July 19.

The first professional paper of the meeting was presented at the opening of the afternoon session, being a discussion of "Design and Operation of Tractional Valves," by James A. Donnelly. This paper included a chart showing the area of orifices necessary in fractional valves to supply varying amounts of radiation, with differences in pressure from ½ oz. to 4 oz. The paper also gave a suggested new arrangement of dial, designed for use under different conditions: (1) For the normal heating of the smallest radiator for which the valve is rated; (2) For the normal heating of the largest radiator; (3) For the quick heating of a radiator. The dial was also arranged so that it would fractionally control the smaller radiator as well as the larger radiator.



AREAS OF ORIFICE NECESSARY WITH DIFFERENT PRESSURE DROPS.



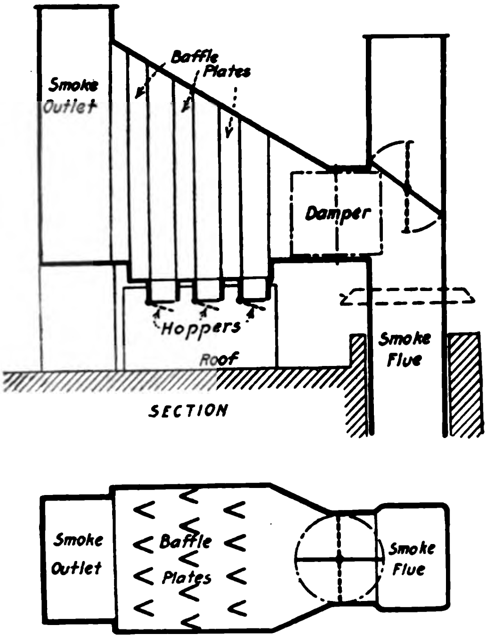
SUGGESTED ARRANGEMENT OF DIAL FOR FRACTIONAL VALVES.

Mr. Hale brought up the point that where fractional valves are designed, for instance, to take care of from 21 to 40 sq. ft. of radiation on a ¾-in. connection, as was mentioned in the paper, it was evident that the control would not be equally satisfactory on say, a 22-sq. ft. radiator and on a 40-sq. ft. radiator. This, he said, showed that some additional control is necessary.

In closing the discussion Mr. Donnelly said he hoped the subject would receive further attention on the part of the society because, judging from the wide variance in the opening of both inlet and outlet valves, the present practice was in a "chaotic" condition.

A paper on "Clean, Pure Air for Our Cities," by a member, was read by Secretary Obert. The paper described the construction and operation of a cinder collector erected on the top of the chimney of a power plant in New York. It consists mainly of a large settling chamber filled with a set of baffles so arranged as to extract the maximum amount of cinders without creating an undue resistence to the flow of gases. The cinders are removed once a week from the hoppers below the settling chamber by means of cleaning doors at the bottom. Ordinarily about 5 cu. ft. of cinders are removed weekly from the collector.

Mr. Baldwin exhibited a dust removal machine of his own design (illustrated in THE HEATING AND VENTILATING MAGAZINE for July, 1916).



CONSTRUCTION OF CINDER COLLECTOR.

A paper by L. P. Dwyer on "Commercial Drying Apparatus," was read by Secretary Obert. The room type apparatus was described, as well as the spray process of milk drying. The author also took up types of progressive apparatus, in which use is made of a conveying belt or screen.

The process of drying garbage was described, using a revolving drum or cylinder.

Mr. F. R. Still said there was a wide field for the heating and ventilating engineer in drying work, especially in foreign countries, and that the principles were little understood in engineering circles.

A telegram of greeting was read from Reginald Pelham Bolton of New York, regretting his inability to be present.

A paper on "Heat Transmission Calculations" by a member, was read by Secretary Obert. Twenty-five engineers were invited to figure the required heating surface for a given suite of rooms. Seven responses were received and the varying amounts given were most remarkable. For the main office the surface ranged from 95 to 216 sq. ft.; for the skylight, from 18 to 112 sq ft.; for the private office, from 32 to 117 sq. ft.; and for the toilet, from 15 to 26 sq. ft. Moreover, the high figures were not all from the same engineer.

The paper expressed the hope that the society's committee on standards will start at the bottom and publish what may be considered good standards for determining these elementary matters.

A paper was presented by Secretary C. W. Obert on "Ventilation of Garages." The danger of asphyxiation, especially in small garages, when the motor is running, led to the suggestion that flexible tubing be run from the muffler to the outside. The author also described the methods in use in larger garages and motor shops, the illustrations including several typical installations, including forms of exhaust flues suitable for garage ventilation. The usual arrangement, it was shown, is a series of muffler tubings, one for each car, connected to a main pipe. This, in turn, leads to an exhaust fan, running thence in some cases directly outdoors and in others, to the chimney flue.

Ann Arbor Session, July 20.

Prof. John R. Allen of the University of Michigan presented the principal paper at this session, which was held in the Engineering Building of the university in Ann Arbor. This paper, which was entitled "Heat Transmission Through Building Materials," gave the results of some unusual tests on heat losses through glass. The principal new feature of this test was the equipment of the testing box which made it possible to get the effects of wind and rain. The box was mounted on trunnions so that the exposed glass could be placed as a window, ceiling, skylight or floor.

The principal fact brought out was that the effect of wind and rain raised the usual coefficient of 1 to 1.485, or practically 50 per cent. more than that used at present.

This, explained Professor Allen, may account for the allowance often made above the calculated requirements, especially in greenhouse work.

M. W. Franklin said it would be interesting to know whether a law could be evolved for the diffusion of heat through building material of different thicknesses, very much as is now done in connection with metals.

Prof. Allen said that further tests on cement and other materials might make it possible to develop such a law.

Regarding the radiant and conduction heat losses, Prof. Allen stated that he never could separate radiant from conducted heat.

The effect of humidity inside of the box was not determined, and Prof. Allen stated that he would take this into consideration, as it might have an appreciable effect. The temperature of the water before and after striking the window also was not taken and, of course, some heat would be absorbed in this way.

He stated that he believed the coefficient was not absolutely a constant and that it would be a bit higher for great differences between inside and outside temperatures. Not sufficient data have yet been obtained to plot a curve for this.

RELATIVE HEATING VALUES OF COPPER AND IRON COILS.

A remark by Mr. Baldwin that there was no appreciable difference in the efficiency of copper and wrought-iron coils in a hot water tank brought out considerable discussion, the consensus of opinion being to the same effect and that the supposed superiority of copper coils was due to its known higher conductivity. The determining factor, however, it was brought out, is the substance being heated and the rapidity with which it passed over the heating surfaces.

R. W. Davenport read a paper on "Notes on Testing of Warm Air Furnaces." The author first spoke of the difficulties in determining the characteristics of a warm-air furnace, which, he said, are seemingly out of all proportion to the simplicity of the furnace itself. He then recounted some of these difficulties, principal among which were the matter of firing, and the determination of the velocity of the warm air.

The results showed that there is a profound influence on the efficiency exerted by the rate of combustion, this efficiency running from 78 per cent. of the B.T.U. content of the coal delivered to the air when burning 15 lbs. of coal per hour, to 86 per cent. when burning 10 lbs. of coal per hour. It was evident, therefore, that for every size of furnace the preferential combustion rates may be defined within narrow limits.

The author advocated the "balanced" method of firing which was used in this test, as it practically insures that any change of observed values is due to the change in the arrangement of the apparatus and not to the change in the rate of combustion through the burning down of the fuel bed.

The discussion brought out the point that while this method of firing is not commercially practicable, it is especially useful in getting accurate test results.

A message of greeting was read from Theodore Weinshank of Indianapolis, who advised that southern floods had prevented him from being present.

The session then adjourned to the Women's Gymnasium building, where luncheon was served.

After luncheon the party was taken to the Hill Auditorium. Here an organ recital was given by Mr. Earl Moore, of the University School of Music. This proved a most delightful entertainment, Mr. Moore's programme being carefully varied.

After the recital an inspection was made of the heating and ventilating equipment of the Auditorium. The party was first shown one of the air intakes and passed along the air corridor to the heaters and fans, which were in operation, delivering air to an unusually large plenum chamber occupying the entire space underneath the auditorium. Air passed into the auditorium through mushroom ventilators under every seat. Exhaust fans at the roof removed the used air through registers in the balcony ceilings. Provisions are made for recirculating the air in warming up the building.

The power house of the university was also visited, and many expressions were heard as to the high type of apparatus installed and the good workmanship shown in the installation. The plant was designed by a member of the society, R. C. Collamore, of Detroit.

In spite of the heat, both indoors and out, many brave spirits were found to be willing and anxious to take the trip through the heating tunnels leading from the power house to the various buildings on the campus. This tunnel is 1,600 ft. long with a temperature in it of 120 deg., and before the end was reached, most of the party were ready to take affidavit that the figures as to temperature, at least should be 1,600.

On emerging from the tunnel the contrast made the outdoor air seem positively chilly by comparison and coats were quickly donned to equalize matters.

The party then proceeded to the Engineering Building where the final paper of the day was read by Prof. J. E. Emswiler, of the University of Michigan, on "Coefficient of Friction of Air Flowing in Round, Galvanized Iron Ducts." This paper, like Prof. Allen's, described recent tests made at the university, the testing apparatus itself being on view on a lower floor.

Morning Session, July 21.

An exhaustive presentation of "Engineering and Cost Data Relative to the Installation of Steam Distributing Systems in a Large City," by F. H. Valentine, was given at the Friday morning session. This paper took up such questions as location, cost and general design of underground steam mains. The latter portion discussed methods of insulation and some interesting data on opening up and replacing pavements, with comparisons of similar data presented at the last annual meeting by Prof. W. F. Verner. For similar classes of pavement, the comparative costs ran remarkably close.

A paper by Prof. J. D. Hoffman was presented on "Heating a Conservatory and Green House." Prof. Hoffman supplemented his description of the installation (which involved the extension of an older plant and provisions for future extensions) with a complete analysis of the new installation. The heating plant in this case was hot water, open tank type, with the radiators and coils all connected on the downward-flow principle; that is, all the hot water from the heater is directed to the highest point of the circulating system, and then subdivided to the various coils and radiators on the return flow.

The final paper was on the "Effect of A. S. M. E. Boiler Code on Heating Boilers," by C. W. Obert. Mr. Obert is the secretary of the Boiler Code Committee of the American Society of Mechanical Engineers as well as of the heating engineers' society. The discussion of this report brought out the information from Mr. Obert that the Boiler Code Committee was still holding monthly meetings to consider suggestions and answer questions regarding the code and to make rulings concerning its interpretation.

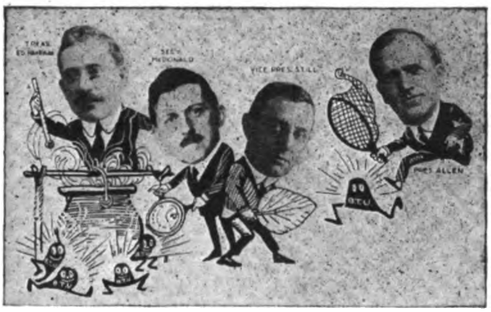
The meeting then adjourned.

The Entertainment.

Under the direction of the members of the Michigan Chapter, headed by President John R. Allen and Secretary William F. McDonald, every spare moment of the meeting was filled with entertainment features. These were not only delightful in themselves, but were carried out with a degree of promptness and dash that kept everyone in high spirits.

First on the programme was a convention luncheon on the opening day of the meeting, served in a room adjoining the convention hall. At the same time a luncheon was served to the ladies at the Fellowcraft Club.

That evening the entire party went over to the Fellowcraft Club for a dinner dance.



OFFICERS OF THE MICHIGAN CHAPTER PREPARING FOR THE DETROIT CONVENTION.

The clubrooms were admirably suited for the purpose and, being on an upper floor, caught the slight breezes that were most welcome in view of the heat.

Professor John R. Allen of the University of Michigan, who is also president of the Michigan Chapter, acted as toastmaster and called upon A. G. Pittelkow as the first speaker. Mr. Pittelkow was followed by President Harry M. Hart of the society, who expressed his admiration for the interest and enthusiasm displayed by the new baby, the Michigan Chapter, and said he was only voicing the sentiments of all present when he stated that the meeting was proving the most successful of the society's many mid-summer meetings.

William J. Baldwin, an honorary member of the society, was then called on for a few words. Mr. Baldwin was attending his first summer meeting of this society and he declared his satisfaction in the programme itself as well as in the many delightful courtesies that had been extended to him.

WILLIAM J. BALDWIN,
Honorary Member of the Heating Engineers' Society.

He expressed his astonishment at the growth of Detroit and declared that the ladies present bore out Detroit's reputation as the home of beautiful women.

Frank K. Chew responded for the trade press. He said not the least service rendered the society by the trade press were its frank statements from time to time as to the society's needs and he predicted a bright future for both the society and the trade press.

Charles W. Locker and Secretary William F. McDonald of the Michigan Chapter were also called on and while each generously credited the other with the success of the arrangements for the meeting, the diners held each equally responsible and their applause for both speakers testified to their appreciation.

After the speechmaking, the guests passed downstairs to the dancing hall where ample room was provided for the dancers as well as for those who wished to watch the festivities.

On the second day, Thursday, the trip was made to Ann Arbor, for the most part, in special automobiles. It was a merry cavalcade that wound its way out to the pretty university city, following, for the most part, excellent concrete roads. A slight shower at Ann Arbor looked threatening for a time, but passed over. As was learned on the return trip, the shower struck a point midway between Ann Arbor and Detroit and the long rows of fallen corn testified to the intensity of the wind and rain. On reaching Detroit, however, the streets were still dry and dusty, showing that the rain had not reached the city.

Most of the automobiles got back to the Statler in time for a six o'clock dinner, although a series of accidents premeditated and otherwise, to two of the cars held them up for some time. It is a terrible thing to find yourself on the road with an exhausted gasoline supply, but it is far more terri-

LADIES PRESENT AT THE DETROIT MEETING OF THE HEATING ENGINEERS.

ble to face such a victim when you are responsible for his shortage. Then, to add insult to injury by fetching a pint supply of the much-needed fluid is almost too much for words. In the interest of truth, it is necessary to state that all of these things happened, although the bold perpetrator of the joke suffered a real calamity when nearing Detroit by having a motor truck muss up his car. Fortunately no one was injured.

Several of Detroit's prominent heating engineers were among those who offered their cars for the Ann Arbor trip, one of the merriest parties being that in Mr. A. G. Pittelkow's car.

In the evening the party repaired to the Woodward Street wharf where the steamboat "Pleasure" was in readiness for the moonlight boat ride and dance. While the boat cruised up and down the Detroit River, dancing was generally indulged in, and downstairs a buffet supper was served. The night was perfect for a river ride and the presence of an unusually large number of ladies added immensely to the success of the occasion.

Friday afternoon, after the meeting was over, parties were taken to the Ford automobile plant and to the plant of the United States Radiator Corporation, where some interesting boiler performance tests were being conducted.

Another party wended its way to the links of the Detroit Golf Club and proceeded to stage a weird and wonderful foursome, with the East pitted against the West. The East won on the home hole with a winning put, variously described as from 10 to 30 yards in length.

The Michigan Chapter members who were actively on duty included President John R. Allen, Frank G. Phegley, Secretary William F. McDonald, J. Deegan and C. M. McSorley.

The Outside Convention.

One of the "life-savers" on the opening day of the meeting was the bunch of palmleaf fans which were distributed at the critical moment just before the opening session, when the heat was getting in its best licks.

Needless to say, it was a coatless convention. After the fans had gotten in their good work, the delegates were ready to enjoy the celluloid-wrapped Havanas, which were distributed at frequent intervals, bearing the inscription, "Compliments of the Michigan Chapter, A. S. H. & V. E., Summer Meeting."

The announcement that Detroit is revising its building code aroused much interest, especially as Mayor Marx has appointed William F. McDonald a member of the building commission which will do the revision work.

Among the absentees who sent regrets were Reginald Pelham Bolton, of New York; Theodore Weinshank, of Indianapolis, and James H. Davis, of Chicago. Mr. Davis was detained by illness and many expressed their interest and hopes for his speedy recovery of health.

THOSE PRESENT.

A. Benbrook, E. F. Capron, E. J. Claffey, J. A. Cutler, C. A. Dunham, Robert L. Gifford, W. B. Graves, John F. Hale, E. L. Hogan, H. M. Hart, R. H. Lindman, E. A. May, C. F. Newport, B. Nelson, E. W. Sanborn, L. C. Soule, J. F. Tuttle, W. S. Hillis, T. Wilson, O. T. Carson and W. H. Burquest, of Chicago.

James R. Bolton, F. K. Boomhower, T. E. Coon, R. Collamore, R. F. Connell, J. E. Deegan, E. L. Downs, R. W. Davenport, Wm. M. Foster, E. M. Harrigan, H. M. Hamlin, N. J. Hill, F. W. Johnson, J. L. Fuller, A. B. Knight, Charles W. Locker, E. J. Lomasney, E. R. Little, J. R. McColl, C. M. McSorley, E. E. McNair, C. J. Peck, G. C. Polk, A. G. Pittelkow, D. H. Petherick, J. H. Walker, C. W. Wheeler, R. S. M. Wilde, F. R. Woolley, L. A. Whitcomb, H. L. Walton, Wm. F. McDonald, N. W. Calvert, T. M. Carrabin, R. T. Craig, F. F. Craig, T. Chester, R. B. Deen, C. W. Farrer, F. B. Fitzgerald, A. P. Gow, T. D. Hayes, N. A. Henwood, Wm. T. Harms, H. H. Hughson, E. Judson, B. E. LaFollette, John C. McCabe, F. J. Singer, R. G. Smith, E. Snell, H. C. Van Sickle, J. B. Webb, H. V. Pearce, G. K. Saurwein, J. H. Trombley and H. B. Lord, of Detroit.

W. J. Baldwin, A. S. Armagnac, J. J. Blackmore, Frank T. Chapman, F. K. Chew, J. A. Donnelly, E. F. Glore, C. W. Obert, Henry D. Bristol, A. H. Ross and George Wood, of New York.

M. L. Cromwell, C. Gottwald, R. J. Mayer, R. S. Mayer, Frank G. Phegley, E. A. Stark, F. H. Valentine, W. Van Sickle, C. F. Beckwith, J. W. Farleye and T. F. Haynes, of Cleveland, O.

Prof. John R. Allen, Prof. J. E. Emswiler and F. Hutzel, of Ann Arbor, Mich.

Charles A. Blaney, Kalamazoo, Mich.

J. F. Firestone, Dowagiac, Mich.

J. D. Cassell, W. J. Robinson and C. P. Hackett, Philadelphia, Pa.

R. R. Jones, Harrisburg, Pa.

M. W. Franklin, East Orange, N. J.

W. J. Braemer and E. K. Lanning, Camden, N. J.

W. G. Brown, Highland Park, Mich.

A. G. Cripps, Akron, O.

H. W. Ellis, F. R. Ellis and L. J. Mueller, Jr., Milwaukee, Wis.

L. L. Byson and P. V. Rozier, Omaha, Neb.

E. C. Lillie, Denver, Colo.

R. W. Noland, Lafayette, Ind.

R. K. Milward, St. Louis, Mo.

J. B. Wigman, Bloomington, Ill.

J. T. McElfatrick, Buffalo, N. Y.

R. J. DeLand, Toledo, O.

J. A. Gurney, Pittsburgh, Pa.

W. H. Thayer, Boston, Mass.

H. N. Booth, Kansas City, Mo.

A. H. Joliffe, Minneapolis, Minn.

L. J. Mueller, Jr., Milwaukee, Wis.

E. E. Hersh, Allentown, Pa.

C. A. Rogers, Toledo, O.

Later arrivals—A. S. Lindeblad, Chicago; E. E. Harris, Detroit; John J. Woolfenden, Detroit; W. R. Stockwell, Irvington, N. Y.; J. W. Williams, Ithaca, N. Y.; R. J. De Land, Toledo, O.; J. B. Dill Detroit; S. W. Howard, Toronto, Ont.; A. H. Jolliffe, Minneapolis, Minn.; C. H. Slaughter, Pittsburgh, Pa.; William C. Skinner, Toronto, Ont.; C. B. Veal, Lafayette, Ind.; Edward H. Vitalius, Detroit and G. D. Wilcox, Detroit,

New Members.

The following new members have been recently elected to the American Society of Heating and Ventilating Engineers:

REGULAR.

Charles R. Ammerman, Detroit, Mich.
Albert L. Baum, New York City.
William S. Blessed, Highland Park, Mich.
James R. Bolton, Detroit, Mich.
F. K. Boomhower, Detroit, Mich.
Warren G. Brown, Highland Park, Mich.
William H. Cadwell, New Britain, Conn.
Richard F. Connell, Detroit, Mich.
T. E. Coon, Detroit, Mich.
Joseph A. Cutler, Chicago, Ill.
Edwin Davenport, Elmira, N. Y.
Ransom W. Davenport, Detroit, Mich.
Edwin L. Downs, Detroit, Mich.
William G. Fraser, Syracuse, N. Y.
John Galbraith, Kelowna, B. C.
Ronald Grierson, London, England.
Daniel C. Halliday, Winnipeg, Man.
H. Archibald Harris, Chicago, Ill.
John E. Henry, Louisville, Ky.
Edgar E. Hersh, Allentown, Pa.
George D. Higgins, Detroit, Mich.
Newell J. Hill, Highland Park, Mich.
Geo. A. Houpt, Philadelphia, Pa.
David S. Jacobus, New York City.
Fred W. Johnson, Detroit., Mich.
Alfred S. Kellogg, Waverly, Mass.
James C. Kenney, Detroit, Mich.
Harry O. Koch, Richmond, Va.
Alfred M. Lane, St. Louis, Mo.
Charles W. Locker, Detroit, Mich.
Edward J. Lomasney, Detroit, Mich.
J. R. McColl, Detroit, Mich.
James H. Marks, Ann Arbor, Mich.
Edgar O. Marty, Detroit, Mich.
Orval H. Matthews, Dayton, O.
Albert S. Mattison, Detroit, Mich.
Konrad Meier, Winterthur, Switzerland.
John F. Miller, Detroit, Mich.
John A. Miller, Cleveland, O.
Francis H. Moran, Staunton, Va.
C. W. Obert, Brooklyn, N. Y.
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Gilbert C. Polk, Detroit, Mich.
Claude V. Saunders, Grand Rapids, Mich.
John A. Stevens, Lowell, Mass.
Edwin S. Storm, New York City.
Carleton F. Tweed, South Minneapolis, Minn.
James H. Walker, Detroit, Mich.
Hiram L. Walton, Detroit, Mich.
Harry S. Wheeler, Elizabeth, N. J.
Charles W. Wheeler, Detroit, Mich.
LeRoy A. Whitcomb, Detroit, Mich.
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Gustave Petersen, New York City.
David H. Petherick, Detroit, Mich.
Ralph T. Sayles, Boston, Mass.
Arthur H. Williamson, Detroit, Mich.

JUNIOR.

George W. Bergen, Omaha, Neb.
George P. Nashman, Cleveland, O.
Peter Tazelaaar, Detroit, Mich.
Peirce M. Wood, Detroit, Mich.

THE BUSINESS OUTLOOK.

VII.

By Frank M. Huston.

Financial Editor of the Chicago Evening Post; Editor Rand-McNally Bankers' Monthly.

We continue to pile up credits abroad and strengthen our financial and commercial position in a way that is most marvelous. Our commerce in the last fiscal year has exceeded all previous records by fully 40 per cent., the aggregate being estimated somewhere between $6,250,000,000 and $6,500,000,000. The total foreign trade in 1915 was approximately $4,443,000,000. The excess of exports over imports in this tremendous volume of trade last year was $1,095,000,000, in round numbers, while it is estimated that the excess for the fiscal year which closed June 30 is not far from $2,145,000,000, and it may exceed that.

In other words, since the European war began the balance of trade in our favor has increased from $470,663,000 to approximately $2,145,000,000, and adding the excess for the two fiscal years that have elapsed we find that our trade balance abroad now exceeds $3,300,000,000.

It is impossible to determine what was the invisible balance, that growing out of the international exchange of things cannot be traced as can merchandise and other commodities. In normal years when tourist travel was heavy this was estimated to be somewhere between $500,000,000 and $600,000,000. The tourist feature last year was almost entirely eliminated and the interest and dividend feature very greatly reduced through the resale of foreign-owned American securities. This necessarily keeps the interest and dividends at home, so that it is safe to say that this annual charge which is referred to so frequently as the invisible trade balance has been cut at least a half and possibly more.

Necessarily all this has a bearing on our financial and business situation and adds to our strength and ability to withstand any shock that may come out of a readjustment either during or following the war. At the present time there is some indication of a let up in our foreign trade. Munition orders are slowing down somewhat and this is manifesting itself in the disappearance of premiums for early delivery of steel and other commodities. But the future course of prices very probably will be determined for some time to come by actual developments or by evidence of known value rather than by speculative sentiment.

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THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

63—What Is the Best Type of Heating System?

QUESTION: What is the best type of heating system, hot air, hot water or steam, for any given case?

ANSWER: This question is continually presenting itself and confronts almost every person at some time in his career. The following article will attempt to point out a few general facts which may be of assistance toward making a wise selection for any given case.

The first consideration is the cost, which should be determined for the different methods in advance. Some of the methods may be eliminated at the start, due to the purpose for which the building is to be used.

As a general statement, at the present time any building may be heated by either hot air, hot water, low pressure or vapor steam, with equally good results if the apparatus is properly designed and installed. On the other hand, any of the above methods may prove unsatisfactory if improperly designed or installed. This generally occurs when the contractor tries to modify the design to meet competition.

Generally, in handling power plant and heating questions, too little consideration is given to the combined system. The heating is handled by an independent heating engineer and the power plant by a power plant expert with the result that there is often too little co-ordination and many advantages are lost. The power plant engineer wants the most economical condensing turbine which forces the heating on a live steam basis in many cases, or the condensing engines are abandoned so as to provide exhaust steam in large quantities for heating. There is no reason why the heating engineer cannot use exhaust steam for heating, and the power expert retain his economical condensing turbine if the heating and power are treated as one problem. This will involve the use of a great deal less for heating in pounds and the cooling effect of the heating system may be utilized to aid in condensing the engines, which makes for the greatest efficiency.

It is in this particular field that there is the greatest opportunity rather than in either the heating field or the power plant field as separate problems.

FUNCTION OF HEATING SYSTEM SHOULD BE KEPT IN MIND.

In making a selection, an analysis of the exact function of a heating system is in order, or a definition. A heating system is a series of conduits by which a fluid is heated at a source, such as a boiler or heater, and circulated to and from the space to be heated where the heat is dissipated. In the case of the hot-blast method, air is passed through a heater operated by steam, water or direct-fired air-tube heater and thence to the space to be heated. In the case of steam or water systems, a direct radiator dissipates the heat from the fluid.

The fluid may be wasted after the heat is extracted or returned to the boiler or heater to be reheated, involving a return system of conduits. The boiler, although an integral part of the heating system, should be considered by itself, as it is common to all the systems, and its efficiency in transferring the heat of the fuel to the medium should be considered separately. The boiler power necessary for each system, both in extreme weather and average weather should be taken into account.

It is readily seen that if a return system is not provided, there is a waste of heat in the fluid discharged, after being used, equal to that required to raise it from the initial temperature to that at which it is discharged from the heating surface. On the other hand, there will be a reduction in first cost by the omission of the return system. The above will apply to all systems, whether circulated by power or gravity. The waste of heat from a water system would be so great that a return system is absolutely necessary.

In all systems, the only loss is the radiation of the piping or conduits, which is dependent entirely on the temperature difference of the circulated medium and surrounding air, modified, however, by the efficiency of the insulation or covering, if used. The rate of transfer of heat from the radiation to the surrounding air is also dependent on this difference.

It is readily comprehended that there are quite wide limits within which the engineer can vary the temperature and volume of the circulated medium to convey the required amount of heat which will affect the first cost and operating expense. The lower the average temperature at which the medium is circulated, the larger the system and greater the first cost. Also the wider the range in temperature, or greater the difference in temperature of the medium between the supply and return, the less the cost of the apparatus and the less the efficiency.

The most economical system will also be the one employing a medium the temperature of which can be varied readily at will to meet outside weather conditions. Where a boiler or heater is used, and the heat is generated directly from the fuel, higher temperatures may be used with economy of installation and operation. Where waste heat from exhaust steam is to be utilized, lower temperatures are imperative for economical operation of the combined heating and power plant, as the lower the temperature of the medium, the lower the pressure temperature of the engine exhaust, and the greater the power economy.

TEMPERATURE AND PRESSURE OF STEAM NO INDICATION OF CAPACITY OR WORK ACCOMPLISHED.

In the consideration of any heating problem, it is well to remember that temperature and pressure are no criteria of capacity or work accomplished. It simply means a higher possible rate of doing work and economy in installation due to smaller mains and less heating surface.

The size of conduits and carrying capacity of a heating system depend on the drops in temperature of the medium or the amount absorbed at the heater and boiler and given up by the radiation. The higher the initial temperature, the greater the possible drop and the less heating surface required, reducing the first cost. Also, the greater the drop, the smaller the conduits and the greater the losses by radiation in transit, although the diameter of the smaller mains will reduce the loss, due to the smaller circumference.

In the selection of a medium such as air, steam or water, there are certain defined temperature limits and physical properties which gives one medium certain advantages over the other. The carrying capacity of a conduit for any medium carrying heat will be determined by the quantity absorbed by one cubic foot for a given loss in temperature. That is, if a cubic foot of air weighs 75/1000 lbs. and absorbs one-fourth of the amount of heat per pound absorbed by water at 62 lbs. per cubic foot, it is readily seen that for one degree drop in temperature the cubic foot of water will convey about 3,400 times the heat that a cubic foot of air will convey. The conduits in either case will correspond, although a more expensive conduit is required for water than for air, due to the nature of the fluid. This accounts for the impractical application of air systems to the transmission of heat any long distance.

Steam has a physical quality of giving up 1,000 B. T. U. approximately of latent heat when condensed to water, although it is 1,700 times the volume of water at atmosphere. It has a volume of 25 cu. ft. to the pound, so as, compared with water, with 25° drop, the quantity would be as follows for the transmission of one B.T.U., or any given quantity of heat:

25 (cu. ft. per lb.) ÷ 1000 (lat. ht.) : 62 (wt. 1 cu. ft. water) × 25 (pres. drop).

However, the velocity of the steam to the water in a conduit may be nearly this ratio due to the lighter density which places them nearly on a par when the drop in temperature of the water allowable is taken into consideration. The above figures are only intended to give an idea of how the natural physical properties of these media affect their use.

When the available velocities are taken into consideration, steam and water are about on a par as far as the size of conduits are concerned. The latter, however, requires a return conduit the same size as the supply, while the steam requires a return conduit only to convey 1/1700 of the volume.

When exhaust steam is used on steam heating central plants, the return is omitted generally on account of the power required to return it to the plant. This waste in operating expense, if the water enters the boiler at 50° to 60° and leaves the heating system at 180°, is equivalent to 12 per cent. in each 1,000 B. T. U., less the heat required to pump it back to boiler.

Another item that owners and architects pay little attention to is the building construction, especially the windows and roofs. It is possible in a large building, especially a high one, to cut down the cost of the heating system and a corresponding yearly operating expense, by paying a little more for a roof that will not leak out so much heat.

Hot Air Systems.

The hot air system has the following characteristics: the air has a specific heat of 0.24 and requires a very large volume to carry any quantity of heat, also large ducts. When circulating the air, power is required generally and a very few B. T. U. will cause a wide loss in temperature, affecting the radiation of the ducts, which must be of large area. The hot air system, however, is very flexible in the regulation of temperatures to meet outside weather conditions, which is its most economical feature. The lower the temperature of the water or steam used to heat the air, the larger the volume of air required and the greater the increased cost of the apparatus.

Owing to the induced leakage, due to the circulation of the air, the hot air system has a very high peak load in extreme weather, about 25 per cent. more than for direct radiation, increasing the boiler capacity. The total fuel for the season, however, due to the flexibility of its temperature, is not very much different from direct radiation. It is, however, impossible to utilize temperatures below 212° on a fan system in the steam or water coils without greatly increasing the cost and operating expense, due to the large volumes and excessive heating surface required. If a wide drop in temperature is used, the volumes may be considerably reduced, making a lower cost apparatus, but if the building is high and the air is discharged at 130° to 140° to heat a building to 60°, the tendency is for the air to rise to the roof, increasing the roof radiation and increasing the heat consumption.

In selecting a fan system, see that there are fairly frequent air changes; not too great a difference between the incoming air and the room temperature and a proper distribution of outlets. Also note the roof construction.

This tendency of the heated air to rise can be overcome in a large measure by placing the fans at a high point in the roof and blowing the air to the floor. If the roof temperature is reduced 10° it will make a difference of 12 per cent. to 15 per cent. in the heat loss through that roof even when it is well constructed.

High velocities in the ducts are not objectionable except that they increase the power for the fan engine or motor, and decrease the radiation losses, due to the less exposed duct surface. In any case, increasing the power to drive the fans decreases the first cost and increases the operating expense. High temperatures of entering air also prevent proper diffusion and cause a loss in that manner.

It occurs in many fan installations that the available exhaust from the fan engine is more than sufficient to heat the building in moderate weather, so they really develop into a live steam proposition 40 per cent. of the time. Recirculation of air should be resorted to in all cases of manufacturing plants, except when commercial processes require fresh air, and then they should be especially provided for in a distinct apparatus. When exhaust steam is to be utilized at temperatures below atmosphere for engine economy, hot water circulation should be used, as it is impossible to heat a building with a fan system only, even with hot water circulation and obtain less initial temperature for exhaust steam operation. It may be done, however, at an excessive outlay in first cost of apparatus. The best method is to combine both the fan system with direct radiation on the same hot water system, reducing the size of both and arranging the system so that the fans will only be required in extreme weather, the direct surface being sufficient to take care of the buildings nights and Sundays.

This will work out at a moderate first cost and a very economical operating expense, the heating system forming an air condenser for the engines. Under these conditions, the fans may be operated by motors from the main engines at the most economical steam rates.

Direct Radiation Systems.

In the use of direct radiation, the most economical installation is with steam from 15 lbs. down, as plenty of pressure is available for flow and reducing the size of mains. The air is easily removed from the pipes and the piping can be installed so as to be noiseless, if the engineer understands his business. The loss in long mains between buildings is less for high pressure steam than for either water, air, or low pressure steam, due to the reduced diameter of pipes. High pressure traps may be used for returning the condensation at slight expense, this making closed circuits. By varying the pressure on the system, nearly the same regulation can be obtained as with hot water for outside weather variation. The first cost of the system is a minimum, and if properly laid out, should give as good satisfaction as hot water. However, it prohibits the use of exhaust steam, which is a serious drawback on a large plant.

Direct Radiation With Low Pressure Steam.

In the use of low pressure steam with a

vacuum, the air can be removed and noiseless circulation obtained, but when high vacuums are attempted on the return, the same difficulty arises as with high pressure steam. It is impossible to operate engines below atmosphere on a vacuum system and, as a rule, back pressure above atmosphere frequently occurs. The loss in low presure steam mains from radiation is higher than either with forced hot water or high pressure steam. The condensation costs nearly as much to return in heat as that recovered from the return water, and is only economical where the saving of water is an object.

There is no flexibility in the system as the temperature is constant and the only way of regulating the temperature of the heated space is by hand control, by opening windows, or by automatic temperature control.

Fractional valves may be used, but then it is largely a matter of individual hand control, which, although very satisfactory from a heating standpoint, may not always tend to economical operation in a large plant. In small installations it does not make a large difference in operating expense what system is used as the first cost will govern largely and they can all be made to give satisfaction from a heating standpoint. The saving of one system over another would not be very great, as the total expense involved is comparatively small and the personal element in the operation will govern to a large extent.

Hot Water Systems.

Hot water may be circulated by gravity or pump, with steam to heat the water, if high pressure boilers are used for power, or with a hot water boiler, if no power boilers are installed. The same arrangement of piping should be used for gravity as with a pump installed in the circuit. The pumps, however, decrease the drop and size of mains, increasing the average temperature of the heating surface for a given initial temperature. Hot water systems may be operated at the same temperature as steam with more efficient results from a standpoint of material. The hot water may, however, be operated at much lower temperatures, if desired. There is no object in this, however, unless the source of heat is at a low temperature and it is desired to use by-products of engine operation.

Hot water circulation is the only system that combines the greatest flexibility of temperature control, with the most econamical operating expense, if properly installed. All steam and water circuits should be closed for economical operation, and drain traps, pumps and feed receivers should be omitted as, when used, the operating expense may be as wasteful as any other system. Hot water heating may be operated on high temperatures with a reduction in first cost without losing any of its advantages of flexibility, and closed circuits for both steam and water.

The only reason for operating with low water temperatures is when it is desired to use steam under vacuum from condensing engines, thus making a condenser of the heating system to the extent of its capacity. Twenty inches of vacuum may be carried, on an average, without any greater first cost on a large installation than for low pressure steam.

The same rules apply to the fan system, the greater the drop in temperature, the more surface required, and the lower the average temperature. Just the same, the less the drop the more water required, and the larger the pumps and power required to circulate. However, by more pumpage, higher average temperature may be used and less heating surface will be needed.

With two heaters, a gravity return for the live steam may be obtained without pumps, traps or other accessories on a high pressure boiler, and the same system may be operated with condensing engines at 20 in. of vacuum, with the exhaust heaters.

In considering the pumpage on a hot water system, as the heat is evenly distributed throughout the system, no matter how small the amount and if the mechanical work is all returned by the friction of the water, it simply means live steam operation to that extent.

The above is only a general dissertation designed to bring out certain physical facts regarding the different methods and would be in no way a condemnation of the selection of any one of the methods or systems for any individual case.

American Society of Mechanical Engineers.

The following nominations have been made for officers of The American Society of Mechanical Engineers: For president, Ira N. Hollis, Worcester, Mass.; for vice-presidents (for two years), Charles H. Benjamin, Lafayette, Ind.; Arthur M. Greene, Jr., Troy, N. Y.; Charles T. Plunkett, Adams, Mass.; for managers (for three years): Robert H. Fernald, Philadelphia, Pa.; William B. Gregory, New Orleans, La.; C. R. Weymouth, Berkeley, Cal.; for treasurer: William H. Wiley, New York.

LEGAL DECISIONS

Apportionment of Mechanic's Lien Among Several Houses.

A dealer in plumbing and heating supplies accepted from a general contractor a proposal for the plumbing and heating of a number of houses, but under an express agreement made with the owner personally that the latter would pay to the dealer directly for such material. After certain of the houses were completed, and before the remainder were begun, the owner became insolvent and was declared a bankrupt. The dealer filed a mechanic's lien for the material furnished. It was held that he was a contractor within the Pennsylvania mechanic's lien law and could file the lien. He was justified in not completing the balance of the contract, and was entitled to file a lien against the houses completed for the material furnished. The completed houses adjoined each other, or had contiguous curtilages. It was held that the dealer might determine the amount to be apportioned to each of the houses, but the justness of the apportionment might be inquired into at the trial.

Where a mechanic's lien has been apportioned among several houses, and the lien shows on its face the various items furnished, with the dates, and that all the material was furnished within the statutory time, the lien will not be stricken off because it fails to show the items of material which went into each house. If none of the material is actually furnished to a particular house within six months, this may be shown at the trial, but is no ground for striking off the lien.—Pierce, Butler & Pierce Mfg. Co. vs. Rogers, 60 Pennsylvania Superior Court, 293.

Action on Installation Contract.

A petition alleged that the plaintiff contracted with the defendant to install the plumbing and heating in a building, that the contract provided for payment upon architects' estimates as the work progressed, that payment of an estimate was refused, whereupon the plaintiff abandoned the contract, but that he afterwards furnished the work by special agreement with the defendant, that there was due and owing him for work performed and material furnished $1,200, after deducting $1,300 therefore paid, and after deducting from the contract price of $2,700 the reasonable cost and expense of installing the heating and plumbing, which sum of $1,200 was the fair and reasonable value over and above the amount paid for the work and material of which the defendant had availed himself, and which he had used, kept, and retained. It was held that, in the absence of an exception, the petition was sufficient to authorize a charge and a verdict either upon quantum meruit or for the balance of the contract price, as the amount due could be definitely ascertained in view of the allegation that the work was to be paid for upon estimates as the work progressed.—King vs. Collins, Texas Civil Appeals, 179 S. W., 899.

Duty of Purchaser of Plant to Minimize Damages from Defects.

In an action on an account stated for installing heating apparatus, in which the defendant counterclaimed for defective performance, it is held that an instruction that the jury could award the defendant such damages under her counterclaim, not exceeding the amount sought, "as you believe from the evidence the defendant was damaged on account of plaintiff's furnishing such defective material and doing the labor in a defective manner, if you believe from the evidence that the material and labor furnished by plaintiffs was defective," was erroneous, because too general, substituting the opinion of the jury for established rules of law as to damages, particularly in view of the fact that the evidence as to damages was vague and inconsequential at best. It was also held that a boarding house keeper, who contracted for the installation of a heating plant in her house, the work being defectively done, and who failed to make the plant good and sufficient herself, as she could easily have done before suffering any appreciable injury through want of such a heating apparatus, could not recover on her counterclaim against the parties who installed the plant any damages for defective performance beyond the cost of making it good and sufficient.—Niebaus vs. Gillanders (Mo.), 184 S. W., 949.

Right to Lien for Heating Plant.

Article 63, Section 2, of the Maryland Lien Law provides that in all cases in which a building shall be commenced and not finished the lien shall attach thereto to the extent of the work done or material furnished. It is held that under this section one who entered into a contract for the installation of a heating plant two months after the building was completed was not entitled to a lien. Section 3 of the act provides that every building erected, and every building improved to the extent of one-fourth of its value, should be subject to a lien for the payment of all debts for work done and materials furnished. It is held that one whose bill in equity to enforce a mechanic's lien for the installation of a heating plant at the contract price of $1,182, in a building improved to the extent of $3,000, did not show that his improvement was more or to the extent of one-fourth of the value of the building in which it was placed, was not entitled to a lien under the section. Shacks vs. Ford, Maryland Court of Appeals, 97 Atl., 511.

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Supplementary Tests of a Magazine Heater.

By E. H. Lockwood.

In The Heating and Ventilating Magazine for May, 1916, p. 18, is a report of tests of a magazine steam boiler, made at the Sheffield Scientific School under the direction of Professor L. P. Breckenridge. The tests were made to study combustion in the magazine furnace, and the operating conditions were varied as much as possible. The fuels used were washed pea and yard pea (equivalent to No. 1 buckwheat).

It was found that the boiler would operate continuously at the maker's rated capacity of over 15 hrs. without attention, requiring only a cleaning of the fire and refilling of the magazine at the end of the period.

The boiler efficiency obtained was lower than that of surface-feed boilers of similar capacity under test conditions. The suggestion was made that lower furnace efficiency might be a characteristic of the magazine-feed with small-sized fuel. This point has not yet been demonstrated for magazine heaters as a class, and occasional tests have been reported showing high efficiency for this style of boiler.

Leaving this point for future settlement, it can be said that, based on the *cost* of the fuel, not on its weight, the efficiency of the magazine heater would be relatively high. The claims of the magazine heater for economy and convenience seem to be well demonstrated.

The sample test showing the performance of a magazine heater contained an error in the analysis of the fuel, which was given as 13,800 B.T.U. per pound of dry coal. More careful analyses have shown that this coal contained 10% ash and had a heating value 13.300 B.T.U. per pound of dry coal.

With the corrected figures the boiler efficiency is increased to 68.3%, a value which has been duplicated in many tests.

SAMPLE TEST OF A MAGAZINE STEAM HEATER.

Operated at 137% of rating. Fired once in 13 hours.

1.	Date of test	Dec. 28, 1915.
2.	Duration of test	26.15 hrs.
3.	Water heating surface	123 sq. ft.
4.	Grate area, projected	4.7 sq. ft.
5.	Kind of fuel	Yard pea, equivalent to No. 1 buck.
6.	Weight of coal fired (two firings)	693 lbs.
7.	Average firing period	13 hrs.
8.	Ash and refuse in coal	15.4%.
9.	Total weight of water fed to boiler	6,080 lbs.
10.	Moisture in steam by separator	0.4 of 1%.
	HOURLY QUANTITIES.	
11.	Coal burned per square foot of grate per hour	5.47 lbs.
12.	Equivalent evaporation per hour from and at 212° F.	240 lbs.
	PRESSURES AND TEMPERATURES.	
13.	Average steam pressure by gauge	5.5 lbs.
14.	Average temperature of feed water	185° F.
15.	Average temperature of flue gases	265° F.
16.	Average draft	0.11 in.
	CAPACITY AND EFFICIENCY.	
17.	Maker's rated capacity, square feet radiation	700 sq. ft.
18.	Boiler capacity during test, square feet radiation	960 sq. ft.
19.	Per cent. of rating developed	137%.
20.	Water fed to boiler per pound coal as fired	8.78 lbs.
21.	Equivalent evaporation from and at 212° per pound dry coal	9.37 lbs.
22.	Calorific value of dry coal by analysis	13,300 B.T.U.
23.	Over-all efficiency, based on dry coal	68.3%.

CORRESPONDENCE

Contractor's Guarantee for Heating System.

Editor Heating and Ventilating Magazine:

What is a model and standard form of guarantee from the heating contractor regarding steam, vapor or hot water heating systems, for residence work especially, a form that is liberal, but conservative, is adapted to nearly all jobs and which would create an atmosphere of confidence with the owner and builder? And suppose the owner or architect wanted a bonding company's liability policy (say one-quarter or one-third the amount of the contract) for one year to guarantee the successful working of the system. What form of guarantee would you advise the contractor to use?

A good guarantee for house heating work and one that will apply to all classes of work is as follows: "We will guarantee to heat all rooms containing radiators to 70° F. in zero weather without attention to the fire oftener than once in eight hours, provided, however, that the apparatus is maintained in continuous operation and the window frames are reasonably tight; also that the plant will operate noiselessly under all circumstances and circulate freely" (in case of steam heating, add "with no pressure showing"; in case of hot water heating, state the water temperature). This form of guarantee, which was used years ago, has become almost obsolete with the overrating of cast-iron boilers.

It is unnecessary to state the steam pressure, as it means practically nothing as concerns capacity. In order to increase the apparent rating of boilers, it was found that by reducing the operating pressure, or temperature, a larger number of square feet of radiation could be carried by the boiler and the lack of capacity of any boiler would not be so obvious. At the same time, the owner thought if he could get heat with no pressure on the boiler he was obtaining an apparatus of great capacity.

As a matter of fact, the reduction of the steam operating pressure in any given case simply lowers the temperature of the cast-iron radiation, increasing the required amount to be installed for any particular job and the owner receives a boiler of less capacity, if anything. If the job calls for 5 lbs. pressure and the same radiation is used as for no pressure, it is readily seen that a larger boiler will be required to maintain the higher pressure on the same amount of radiation.

There is this to be said, however, where no pressure is used, there is not so much danger from noise due to improper piping work.

Capacity of Fans to Carry Saturated Air.

Editor Heating and Ventilating Magazine:

I have been searching for some three or four years for an adequate explanation of the fact that air forced through a blower cannot be made to carry a humidity much in excess of 50 per cent. of saturation. The only reference I have been able to find is the following quotation from the Kent I had in college. I should like to have either a reference to a more modern discussion and scientific description of the reasons for this, because it is a decidedly important factor in the artificial drying of lumber.

(Slow Evaporation.—The principal idea carried into practice in machines acting by slow evaporation is to bring the wet substance repeatedly into contact with the inner surfaces of the apparatus, which are heated by steam, while at the same time a current of hot air is also passing through the substances for carrying off the moisture. This method requires much heat, because the hot-air current has to move at a considerable speed in order to shorten the drying process as much as possible; consequently a great quantity of heated air passes through and escapes unused. As a carrier of moisture, hot air cannot in practice be charged beyond half its full saturation; and it is, in fact, considered a satisfactory result if even this proportion be attained. A great amount of heat is here produced which is not used; while, with scarcely half the cost for fuel, a much quicker removal of the water is obtained by heating it to the boiling point.—Kent, 1899 edition, p. 466, describing experiments of Emil Passburg, Proceedings Mechanical Engineers, 1899.)

It will simplify a discussion of this question to consider what happens in the drying operation. In the first place, as the air becomes saturated and if there is no other means of heating it after its introduction, the temperature is bound to lower and the relative humidity is bound to increase. However, the determining factor is the relatively large amount of air which has to be handled in order to maintain the required temperature and overcome the losses through the walls, ceiling and floor of the dryer itself. Additional air has to be handled to take care of the heating of the cars or other conveying mechanism.

Under these circumstances it is not considered a good commercial proposition to attempt to saturate air much above 40 per cent., as the drying process would be slowed down to such an extent that the time required to do the drying would cause a greater amount of heat to be consumed than is necessary if the air is permitted to escape at a lower relative humidity.

There is no engineering reason, however, why the air cannot be completely saturated. In a plant installed by the American Blower Co., of Detroit, Mich., in Cuba, the air was applied at such a high temperature that they had complete saturation when the outside temperature was 90° F., the air escaping from the dryer having every appearance of steam.

It would be impossible to have 100 per cent. saturation with a low temperature of air, but it is an easy matter to have 70 per cent. or 80 per cent. at almost any temperature above the freezing point, if the volume of air is properly proportioned to the material to be dried and the material is such that it freely gives up its moisture. On the other hand, if the temperature of the air were applied above the boiling point, it would be easy to saturate it up to 100 per cent., if there is sufficient moisture freely thrown off by the material. The blower has nothing to do with the degree of saturation other than serving as a mechanical means of causing a movement of the air.

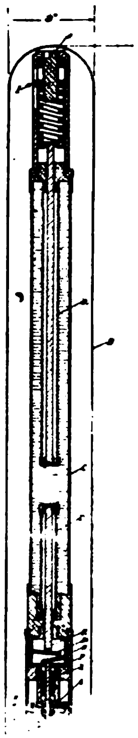
NEW DEVICES

Sarco Thermo Switch.

A modification of the Sarco temperature regulator, designed to operate an electric switch, has been brought out by the Sarco Co., Inc., Woolworth Building, New York, under the name of Sarco thermo switch. This apparatus combines the expansion element of the ordinary Sarco regulator for steam, gas and water valves, with a specially-designed switch, as shown in the accompanying illustration. It is intended to furnish a means for operating electrically a switch for controlling a supply of current for heating, or a motor for the distribution of hot air, or for any other purpose requiring the control of an electric circuit by temperature changes.

The instrument has a calibrated scale from 58° to 78° F and is intended to operate the switch with a change of approximately 2° in temperature. It can be built for any temperature up to 325° F.

The operating mechanism employs a brass tube filled with a heavy hydro-carbon oil which, on expansion, compresses a Sarco spiral tube inserted in the oil. The expansion pushes a rod out of the end of a tube, the movement being multiplied by levers. A movement is obtained sufficient to operate the snap switch even with very slight changes in temperature.



CONSTRUCTION OF SARCO THERMO SWITCH.

In the illustration the instrument is shown in the hot position, with the plunger extended. As the instrument changes to "cold" position, the rod R is slowly withdrawn into the tube, followed up by the plunger P. This operation is based upon the action of the spring X. The insulating member carrying the switch blade F is held in its illustrated position by the brass seat against which it rests.

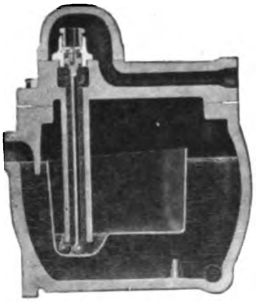
Therefore, when the plunger head is withdrawn slowly through this insulating member, it expands the spring S, which is an endless coil-spring free to roll from one end to the other of the plunger head. As

the plunger draws through this switch member F, the spring S expands and as the thickest part of the plunger head passes through the center of the spring S, the compression of the spring S causes it to travel down the plunger head taking along with it the insulating member containing the switch arms, which then hop over and locate themselves on the terminal posts T. This closes the circuit. This condition then obtains until the process reverses itself by application of a warmer temperature.

This switch, it is stated, is perfectly safe to operate on a 220-volt D.C. or A.C. circuit and it will carry 5 amperes. Its action is said to be very quick and positive. Also the device has been found to work with lamps in series without causing a flicker.

Swartwout Hydromatic Trap.

Two of Nature's unchanging forces, gravity and buoyancy, are applied in a new steam trap, which has just been brought out by the J. D. Swartwout Co., Cleveland, O. These two forces control the operation of the discharge valve through their effect on the float bucket to which the pull rod of the valve is attached. The trap contains but two movable parts, the discharge valve and the float. It is stated that the discharge valve and seat are practically the only parts that ever need replacing. As these are made of a special metal, and their movement is intermittent, either wide open or shut tight, there is no chance to wire-draw.



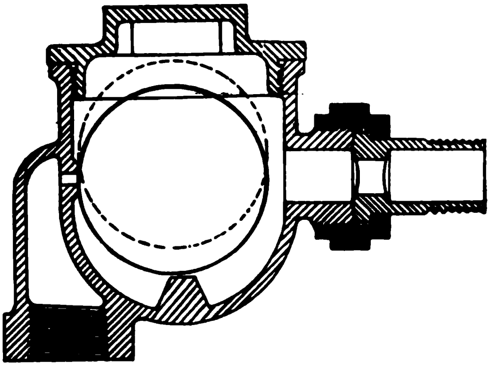
SWARTWOUT HYDROMATIC TRAP.

The valve and seat are located in the top of the trap, enclosed in an independent chamber formed by the cap. This cap can be remved and the two parts exposed by removing the cap nuts.

As the Hydromatic trap is extra heavy, it can be used under any pressure from 0 to 250 lbs. It is guaranteed to perform up to its rated capacity. The trap is furnished in seven sizes, running from ½-in. up to 3-in. with corresponding radiation capacities of from 2,130 to 51,900 sq. ft. of radiation. The valves and seats are made in seven sizes (interchangeable).

A New Radiator Trap.

An interesting development in radiator trap construction is shown in the J-M radiator trap, made by the H. W. Johns-Manville Co., New York. It operates on the same principle as the J-M steam trap. There are but three parts, the body, connecting union and the rolling ball. The trap has no springs, counterweights, thermostatic parts, regulating screws, expanding liquids or restricted air passages. It can be used on any radiator connected on a two-pipe system and under any pressure ordinarily met with in heating, up to 10 lbs. It is stated that the trap will take care of the condensation from any radiator having a heating surface of 250 sq. ft. or less.



J-M RADIATOR TRAP.

In operation, the hollow, seamless, unattached copper ball covers the discharge orifice and serves to prevent the loss of steam. When condensation enters the trap, the ball rolls up, exposing the discharge opening, permitting a discharge of water and air without loss of steam. This discharge, it is pointed out, is constant and automatic.

In a typical plant in the Roger Morris apartments, at Colonial Avenue and 160th street, New York, where 502 of these radiator traps are in use on the radiators and on the drips of risers, tests show that the system can be heated with ½-lb. gauge pressure, when the outside temperature is 10° F. When the gauge hovers around zero, the radiators on the top floor were hot. It was also noticed that even with quick steaming there was no hammering of steam in the pipes.

New Water Tube Heating Boiler.

A new type of heating boiler is soon to be put on the market. It will be known as the Seabury safety water tube heating boiler of the low water-line type, and will be manufactured by the Gas Engine & Power Co. and Chas. L. Seabury & Co. (consolidated), at Morris Heights-on-the-Harlem, New York. This firm has long made the Seabury water tube boilers for marine service. The new type will be built in units of 25, 45 and 60 H.P. and larger requirements will be met by combining two or more units. The boiler will be built for a safe working pressure of 50 lbs. The height from the floor to the drum has been kept down to 6 ft. 1½ in. One of the first installations is in the new Southern Drug Syndicate Building, in Houston, Texas.

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Spun Glass as a Pipe Covering.

Successful experiments are reported from Germany in the use of spun glass as an insulating material. It is stated that, in addition to adding less to the weight of the pipes, it is considerably lighter even than cork. It is also insensible to the vibration of the pipes and is not affected by high temperatures, or by water, steam or acids. It is also found to be very durable.

In installing this form of insulation, rings of asbestos are placed at intervals around the pipes and between the rings the spun glass is wound loosely around the pipes. The whole is then enclosed in asbestos braid and sailcloth and painted with tar or oil-paint.

The spun glass consists of extremely fine glass threads, from 0.03 to 0.05 mm. in diameter, and forms loose, porous wadding. The insulating capacity of this material is said to be due not only to the air held in these interstices, but also to the fact that the mirror-like surfaces of the glass constantly reflect the heat.

◆

How Often a Regrinding Valve Will Open and Close.

An interesting contest was conducted by the National Tube Company at the recent annual convention of the National Association of Master Plumbers, the competitors being asked to guess the number of times a "N. T. C." regrinding valve had been opened and closed. The valve in question had been in use in connection with a Kewanee union testing machine and those entering the contest were asked to base their guess on the appearance of the valve.

Several hundred estimates were received, the nearest to the correct answer being received from R. C. Gebhardt, 19 South 13th Street, Easton, Pa., of the firm of E. & R. Gebhardt, heating and plumbing contractors. Mr. Gebhardt's estimate was 4,250,000, whereas the actual number, as shown by affidavit, was 4,623,956 times. The prize was a walrus skin bag.

Two were tied for second place: Lewis S. Bowker, 312 Madison Avenue, Atlantic City, and John R. Reeves, 2301 South Hoover Street, Los Angeles, Cal., whose estimates were 5,000,000 each.

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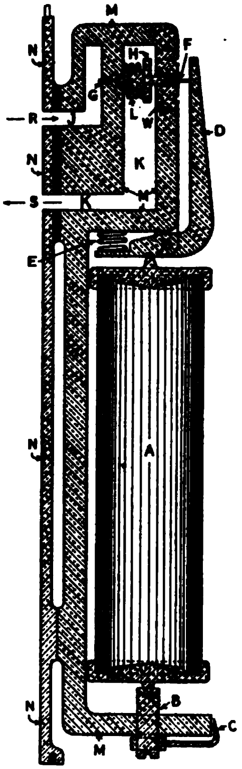
Trade Literature.

American System of Heat Control is brought to the attention of the trade in a carefully-prepared catalogue issued by E. F. Houghton & Co., Philadelphia. This old-established company, which has long been a well-known manufacturer of petroleum lubricants, took up the marketing of heat-



THERMOSTAT USED WITH AMERICAN SYSTEM OF HEAT CONTROL.

A—thermostatic element. B—adjusting screw. C—indicator hand. D—lever. E—heavy spring. F—exhaust port. G—inlet port. H—valve. J—passage conveying air at 15 lbs. pressure. K—passage carrying air to the diaphragm motor or valve at the heating source. L—weaker spring. M—casing. W—adjusting block.

ing appliances in 1895, when it placed on the market the Marck steam trap. In December, 1915, the company purchased the business of the American Regulator Co., of Pittsburgh, together with the entire organization, thus combining the American system of heat control with the Houghton heating and engineering department. Fewer working parts, it is stated, are to be found in the American thermostat than in any other. It is made in two types, graduated and positive. The graduated type is designed to control the hot air damper in relation with the cold or tempered-air damper and it is also used on vacuum steam or hot water heating systems to operate the diaphragm radiator valves. The positive type is used to operate diaphragm control valves on either direct or indirect radiation where the system is one or two-pipe steam. A hollow, hard rubber tube is used as the thermostatic element. The caps on the top and bottom of the tube are perforated, permitting the circulation of the room air within the tube. A typical installation of a fan heating system is also shown in the catalogue, with graduated thermostat control, as is commonly used in schoolhouses. The American diaphragm radiator valve is also shown, being made in all patterns and sizes from ½ in, to 2 in., all made with rubber diaphragms. It is stated by the company that experiments are now being made with a metal diaphragm for use in a radiator valve and also for coil valves in connection with steam blast heating. The company also makes the American hygrostat for humidity control, the general construction of which is illustrated in the catalogue. Size 8 x 11½ in. Pp. 24.

Connersville Victor Blowers and the many services they will render are listed in a compact circular issued by the Connersville Blower Co., Connersville, Ind. In addition to their use for vacuum heating work, they may be applied to gas appliances, gas furnaces, laundries, oil furnaces, brazing forges, soldering, vacuum cleaning, pneumatic conveying, cooling liquids, etc. Among their notable features are listed the following: no valves or valve ports, only two moving elements, no light or delicate parts, no internal contact or wear, no reciprocating motion, no reversals to limit speed, balanced at all speeds, minimum vibration, handles clean air (no oil required), has four large ring-oiled bearings, and is furnished in all sizes and capacities.

Tuec, the Heart of the Home, featuring the Tuec stationary vacuum cleaner, is the subject of new circular matter issued by the Tuec Co., Canton, O. This outfit is now made in fifteen sizes, and attention is called to the fact that it was awarded the international grand prize at the Panama-Pacific International Exposition.

Heart of the Heating Plant is the title given to the Minneapolis heat regulator in a circular describing this device which is made by the Minneapolis Heat Regulator Co., Minneapolis, Minn. In addition to showing the various styles of this instrument the circular reproduces comparative recording temperature charts with and without the regulator, showing the uniform temperature and fuel saving effected with the regulator in use.

Hot Water in Abundance for Domestic Supply is the title of a circular sent out by the Philadelphia Steam Heating Co., Juniper and Cherry Sts., Philadelphia, Pa., calling attention to the Philadelphia water heater which, it is stated, will perform the same service at a small fraction of the cost of heating by gas. The heater is a small coal-burning water-jacketed stove which may be set at any place in the basement near a chimney and connected to the range boiler or to an independent storage boiler. For the winter supply a connection can be made to the steam, water or vapor heater. It is figured that one hod of coal, at a cost of 5c. per day, will operate the heater during the summer. The heaters are made in a wide range of capacities.

Monash Vacuum System of Steam Heating is presented in a convincing manner in a new catalogue issued by the Monash Engineering Co., Chicago, Ill. The unique diaphragm used in the Monash thermostatic return line valve is described in detail. It is in the form of a disc made of phosphor bronze, with metal walls 125 per cent. heavier, it is stated, than any other type of diaghragm. It is not attached to the cover or the body of the valve in any way, but is dropped into place in the valve between the plunger and adjusting screw. Another important feature of the Monash thermostatic return line valve, it is pointed out, is the dirt pocket constructed in the form of an inverted weir, producing a water seal and preventing the passage of steam to the diaphragm of the valve. The weir also acts as a deflector for the dirt, scale, etc., which fall to the bottom of the dirt pocket and may be removed by opening the by-pass screw. The dirt is then drawn by the vacuum into the return lines and finally into the Monash suction strainer at the vacuum pump. Typical layouts of a Monash vacuum heating system, with exhaust steam and a Monash vapor heating system, are included, together with the necessary data covering Monash pressure regulating valves, Monash vacuum pump governors, Atlas noiseless back pressure valves and Monash suction strainers. Size 5¾ x 8¾ in. Pp. 28.

Molby Down-Draft Boilers are discussed in a new edition of the Molby catalogue, issued by the Molby Boiler, Inc., 103 Park avenue, New York. In addition to describing this well-known heater, the catalogue contains many suggestions regarding the proper boiler to select, the proper coal to burn, and old and new methods of firing, while considerable space is given over to a discussion of chimneys, including such points as area, height and construction. Complete data are included covering both the Molby steam and water boilers. Size 4 x 8 in. Pp. 24.

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New Webster Catalogue.

The importance of the modern engineering catalogue is reflected in the latest volume received from Warren Webster & Co., Camden, N. J., devoted to the Webster vacuum system of steam heating. In general scope and typographical appearance this catalogue takes rank with anything of its kind that has appeared in some time. After calling attention to the 28 years of this firm's activity in the vacuum steam heating field, during which time more than 500,000 radiators and coils have been equipped with Webster valves, the catalogue takes up "The Disadvanatges of Older Methods," and "The Application of Vacuum to Steam Heating," followed by carefully written matter on the advantages of the Webster vacuum system and the design and installation of this system. This goes into great detail and is profusely illustrated with such details as typical pipe coil connections, fan heater tappings and connections, up-feed and down-feed systems, lifts and grading of mains. A special section is devoted to the Webster sylphon trap and other sections take up the Webster No. 7 trap of the diaphragm type, and the Webster water-seal trap.

After describing these and other Webster specialties, considerable space is given up to the Webster modulation valve, with illustrations of its construction and application. Typical installations of the Webster hydro-pneumatic system and the Webster pres-co vacuum system are accompanied by descriptive text showing how each operates. Fifty pages of buildings equipped with Webster systems, which conclude the catalogue, form an impressive exhibit of the wide use of the Webster system. Size 8 x 10. Pp. 144.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK SEPTEMBER, 1916

New York School Heating Practice

With Special Reference to New York City Public School Buildings

By FRANK G. McCANN.*

(From a paper read before the Municipal Engineers of New York City.)

The city of New York has a school population of over 690,000 children, a population greater than the entire population of any other city in the United States, aside from Chicago and Philadelphia. The school registry of the city of New York exceeds the combined school registry of the next five largest cities of the United States.

Again, the amount of coal burned per annum for one school may seem small and not important, being only from about 10 tons for a one-room portable school up to 1,500 tons for the largest high school, but it is hard to realize that the total annual coal bill for all public schools of this city amounted to about $600,000, as shown in Fig. 1; a goodly sum and one worthy of vast thought and study looking to its reduction to the lowest limit compatible with the health of the pupils and the dictates of efficiency.

Out of nearly 700 buildings, most of them are more or less obsolete, and it is difficult to conceive of any type of heating or ventilating system that is not or has not been found in some one of these buildings.

Even now it is difficult to obtain adequate funds to provide proper equipment or to have the excellent modern equipments with which the more recent buildings are provided, adequately operated; the State law requiring adequate ventilation of school rooms, etc., does not apply to this city.

PRESENT METHODS OF DESIGN.

When a new school is contemplated, the board of superintendents select a locality where, in its judgment, based upon school census, etc., an additional school is needed, and what number of rooms, etc., such building should have.

Upon receipt of such data, estimates of costs for the different features entering into the building are made up and money is asked from the Board of Estimate for such building. If the desired

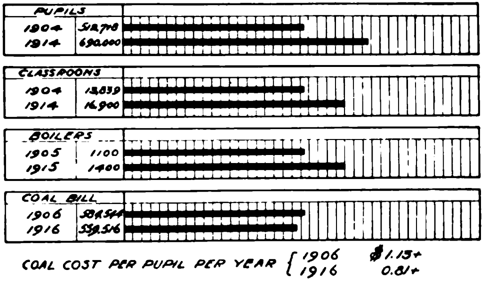

FIG. 1.—COMPARATIVE INCREASE IN FUEL CONSUMPTION IN NEW YORK CITY PUBLIC SCHOOLS.

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*Chief of Heating and Ventilating Division, Board of Education New York City.

money or any part thereof is granted, sketches for the new building, on the basis of the available funds, are prepared and considered by the Board of Education; when sketches have been approved by them, the contract drawings are proceeded with.

The heating and ventilating work is sketched out during the progress of the general construction drawings, so that flues, boiler-plant, etc., may have space alloted and provided under the construction contract.

Since the funds are never copious, there have, of course, to be many compromises in order to get all the class-room facilities, etc., deemed necessary and still keep within the appropriations.

Notwithstanding the above, the heating and ventilating installations of the more recent public schools have been pronounced by various trustworthy and unbiased authorities to be among the best in the world.

HEATING.

In the majority of the newer buildings the heating is accompished by means of cast-iron radiators of the type commonly used in offces and apartments, placed exposed in the rooms dïrecty underneath the windows.

The heating surface or heating effect of such radiators is so calculated as to provide sufficient heat to warm the respective rooms from zero to 70° F. within a period of about four hours and is, therefore, more than sufficient to maintain the rooms at 70° F. in zero weather.

For economy of coal and labor, especially where forced draft is used in the boilers, the boilers are shut off from the heating system as soon as the school session ends for the day, and the fires are cleaned and banked, ready for quick starting up the next morning.

The building, therefore, becames very cold during the night in severely cold weather and especially when high winds accompany low temperatures. (In cases of winds as high as 70 miles an hour and nearly zero temperature, it has been necessary for the janitors to keep up some steam all night to prevent freezing of plumbing fixtures, but this is rare in New York City.)

An excess of heating surface over what is necessary merely to maintain the desired temperature of 70° F. is also necessary because of the long periods of non-occupancy of the building, such as during the Christmas-New Year's vacation, etc., when it would not pay to keep the building heated more than is necessary to prevent freezing of the plumbing fixtures; in fact, one winter when coal was hard to get, the plumbing fixtures were drained and no fires were kept at all during the Christmas vacation period.

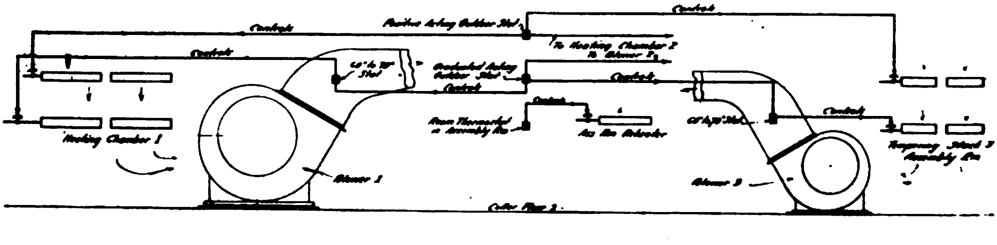
ARRANGEMENT OF AUTOMATIC HEAT CONTROL.

With this excess radiation, it would be difficult to prevent overheating, especially in mild weather, unless some means of automatic control were provided.

This phase of the problem is cared for in three ways:

1. By installing a system of automatic heat regulation local to each room:

2. By automatically controlling the temperature of the fresh air supplied to the rooms for ventilation; and



Diagramatic Sketch showing Thermostatic Control on Indirect Radiation
No Scale

FIG. 3—THERMO CONTROL OF INDIRECT RADIATION.

3. By hand-operated pneumatic control of steam-risers, whereby the number of risers and hence of radiators, may be reduced roughly in proportion to the outdoor atmospheric conditions.

The temperature of the fresh-air supply to the class-rooms, etc., is automatically controlled by a thermostat placed in the trunk duct near the plenum blower discharge as shown in Fig. 2, and to facilitate stabilizing of room temperatures, the functioning point of such duct thermostat is automatically determined by means of a special graduated-acting thermostat, shown in Fig 3, placed out-of-doors, which special thermostat automatically adjusts the regulating screw of the duct thermostat so that when the temperature out-of-doors is zero F. or thereabout, the duct thermostat maintains the fresh-air supply at about 72° F., whereas when the outdoor temperature rises to about 40° F., the duct thermostat is automatically set to maintain the fresh-air supply at about 65° F.

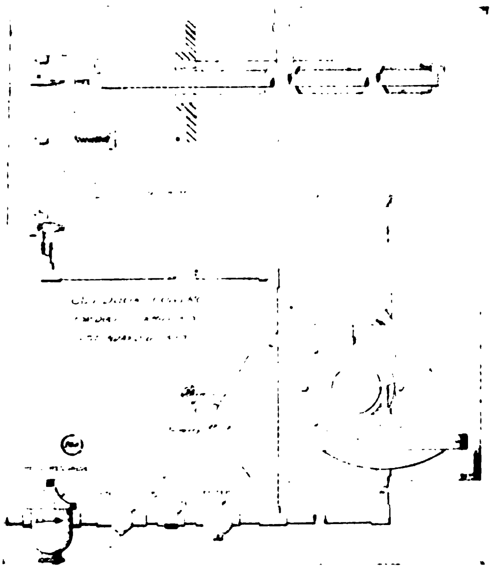


FIG. 3—OUTDOOR CONTROL FOR DUCT THERMOSTATS.

By this means the rooms receive cool refreshing air when there is a tendency for them to become overwarm but are supplied with warm non-chilling air when severe cold weather out-of-doors renders the occupants susceptible to draftiness or cool breezes.

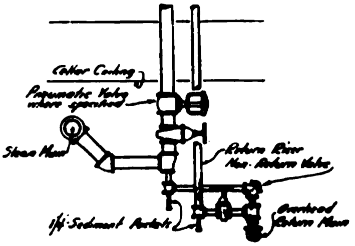


FIG. 4—RISER CONTROL VALVES, PUBLIC SCHOOL 50, BROOKLYN.

For the riser-control system, a diaphragm pneumatic valve is inserted in each steam riser, shown in Fig. 4, and a ¼-in. air-line is run from each such valve independently or in groups of several risers passing through rooms having the same exposure, to a three-way cock mounted on a neat board at a location convenient to the janitor, shown in Fig. 5.

Also the radiating surface in each class-room is divided into two or more units, each served by a separate riser.

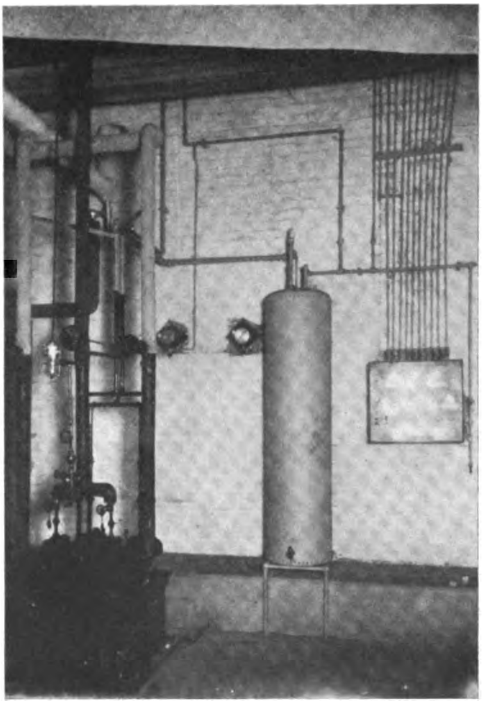


FIG. 5—AIR COMPRESSOR, RISER CONTROLS, ETC., PUBLIC SCHOOL 50, BROOKLYN.

This obviates the possibility of all heat being shut off from any room or tier of rooms in case of a broken or leaking radiator or riser, and, in conjunction with the above-mentioned rise-control system, this enables the attendant to close off about one-half the radiating surface when the temperature out-of-doors or the direct heat of the sun in rooms on sunny side of the building renders a reduction of heating surface advisable or desirable.

Fig. 5 shows the riser-control board, the air-supply for which is taken from the pressure tank of the temperature-regulating system adjoining same.

In order to avoid overheating the pupils seated near to the direct radiators in class-rooms, sheet-metal shades are placed in front of such radiators, serving to reflect the radiant heat and to form flues in which the room air may be heated by such radiant heat and carry same to the room by convection currents. These shields are securely supported 2 in. away from the radiator by means of cast-iron separators and stove bolts, each run through a washer, the shield and separator and tapped into a boss provided for this purpose in radiator edge on end and occasional intermediate sections.

VACUUM SYSTEM.

All radiators are connected to steam and return risers and have hand-valves in steam-supply, in addition to pneumatic valves, only where not connected to risers having riser control or in case there are special reasons of frequent non-use of room, etc., to necessitate hand-control for the sake of economy.

Every radiator has a non-return or vacuum-valve in connection to return riser, of such type as to be operated by accumulation of water or air but to permit no steam to escape.

The steam-risers are dripped into return mains through similar vacuum-valves or equivalent steam-traps, and a

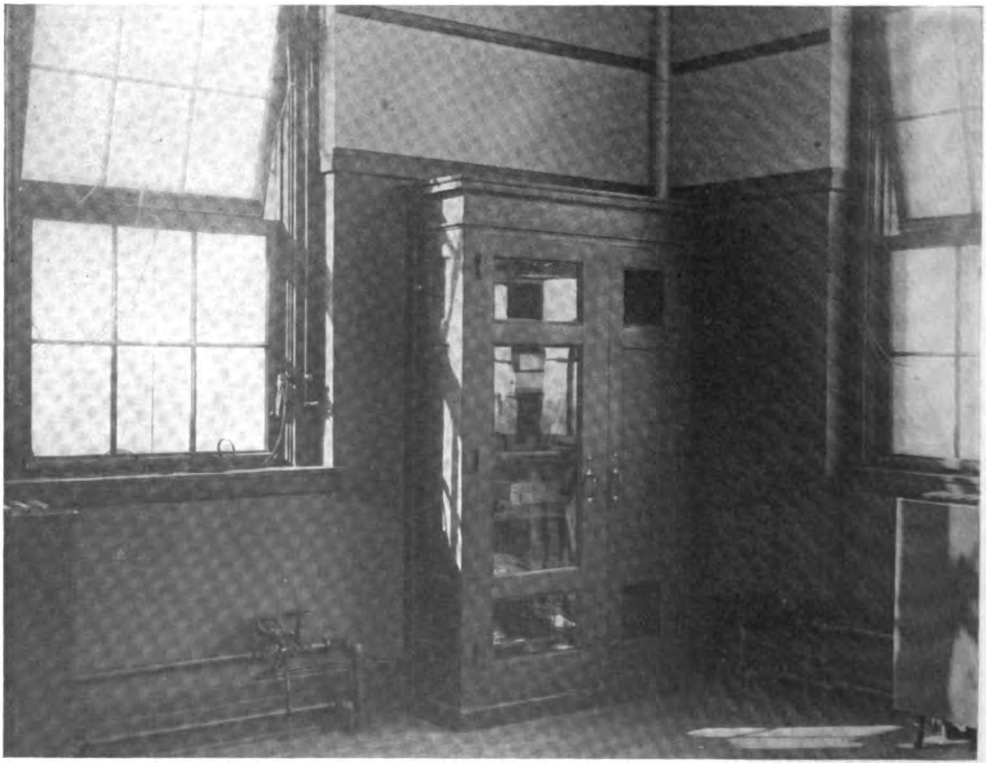


FIG. 6—TYPICAL OPEN-AIR CLASSROOM, PUBLIC SCHOOL 50, BROOKLYN.

dirt pocket is formed underneath each such drip to catch sediment from riser and prevent choking of trap, as shown in Fig. 4.

A vacuum of about 5-in., mercury gauge, is ordinarily maintained on the return lines, by means of simplex vacuum-pumps, steam or electrically-driven according to circumstances. The vacuum-pumps are, however, capable of maintaining a much higher vacuum and as high as 14 in. is used when starting up from cold building. These pumps draw from a submerged header.

The tightness of the return lines is assured by a test of all such lines under an air-pressure of 30 lbs., which will show up leaks in lines that have seemed perfectly tight under a cold-water test at 100 lbs. pressure.

The vacuum-pumps deliver the condensation from the heating system into an open receiving tank, with a large vapor pipe taken from the highest point of pump discharge, just above top of tank, to atmosphere. To conserve the vapor in this condensation, the make-up water for boiler-feeding is fed into the above tank through the vapor pipe, thereby acting as a jet condenser.

VENTILATION.

There is much skepticism in the daily press and even among the medical profession as to the value of or necessity for mechanical ventilation in schoolrooms, and great claims have been made for so-called open-air or outdoor classes. (Fig. 6.) Excellent showings have been made in such open-air classes, but it is hard to determine what portion, if any, of the benefit to the pupils is due to open air as differentiated from the effects due to special clothing, special food, small classes, special teachers, etc., accompanying such open-air treatment. The fact that the teacher of an open-air class, in addition to having a smaller class, also gets $100 per annum more salary than when teaching a normal class may also be persumed to have some slight tendency to make such classes popular with the teachers.

Owing to the uncontrollable loss of heat through the wide-open windows of an open-air class-room, it is quite evident that there will be more coal required to heat such a room than for a closed room with mechanical ventilation supplying controlled volumes of warmed air for ventilation.

This matter of what constitutes good, adequate ventilation, and the best means to obtain same, has for years past been a bone of contention among engineers, medical men and others and the end is not yet.

In the meantime the new buildings are being equipped with mechanical ventilation, adequate to supply every pupil with at least 30 cu. ft. of fresh warmed and humidified air, taken from as clean a source as practicable, and maintaining comfortable range of tempeartures without noticeable draftiness in the rooms, and such conditions are found generally quite satisfactory to the pupils and teachers.

Of course, not every installation gives entire satisfaction to the occupants, partly because some janitors are unable or unwilling to properly maintain and operate the ventilating systems, and partly because many teachers, used to open windows in the older unventilated schools, refuse to co-operate in the use of the mechanical ventilation systems, claiming that they cannot endure the "canned" or "cooked" air, and failing to realize that nothing detrimental has been added to the air and, so far as chemical or physical analysis has been able to show, nothing whatever (except a little dust) has been taken from the air by its passage through the heaters, blower and duct-work in its passage from out-of-doors to the class-room.

VENTILATION APPARATUS.

For ventilating schoolrooms out-of-door air is ordinarily drawn into a vertical downtake, lined with enameled brick, from an inlet placed at about mid-height of the building as shown in Fig. 7, equally remote from the dust of the streets and from the gases and odors issuing from the smoke-stack, toilet vents and the exhausters drawing out the vitiated or used air from vent flues.

The "selected" air is drawn through steam-heated cast-iron indirect heaters painted on all surfaces and spaced so far apart that dust cannot accumulate thereon. These heaters warm the air to a temperature not exceeding 72° F., so cannot be said to "cook" or overheat it, especially as the air is only momentarily in contact with such heated surface, being drawn over same at a velocity of 800 to 1,200 ft. per minute.

Clean, fresh water is then evaporated into this air in such quantity as to bring the warmed air up to proper relative humidity, which varies with the outdoor temperature.

The warmed and humidified air is then drawn into a steel-plate blower or ventilating fan, shown in Fig. 8, which thoroughly mixes the air and forces it through sheet-metal ducts and flues, etc., into the class-rooms.

The temperature of this fresh air for ventilation is automatically controlled as hereinbefore described, the humidity is similarly controlled, and the resulting temperature and humidity are such as to maintain in the class-rooms as nearly as possible that balmy feeling which has led the poet to chant "O! what is so rare as a day in June!"

This warmed and humidified fresh air is delivered into the class-rooms through two or more inlet openings, with wire screens inserted in same, mostly for appearance sake. These fresh-air inlets in

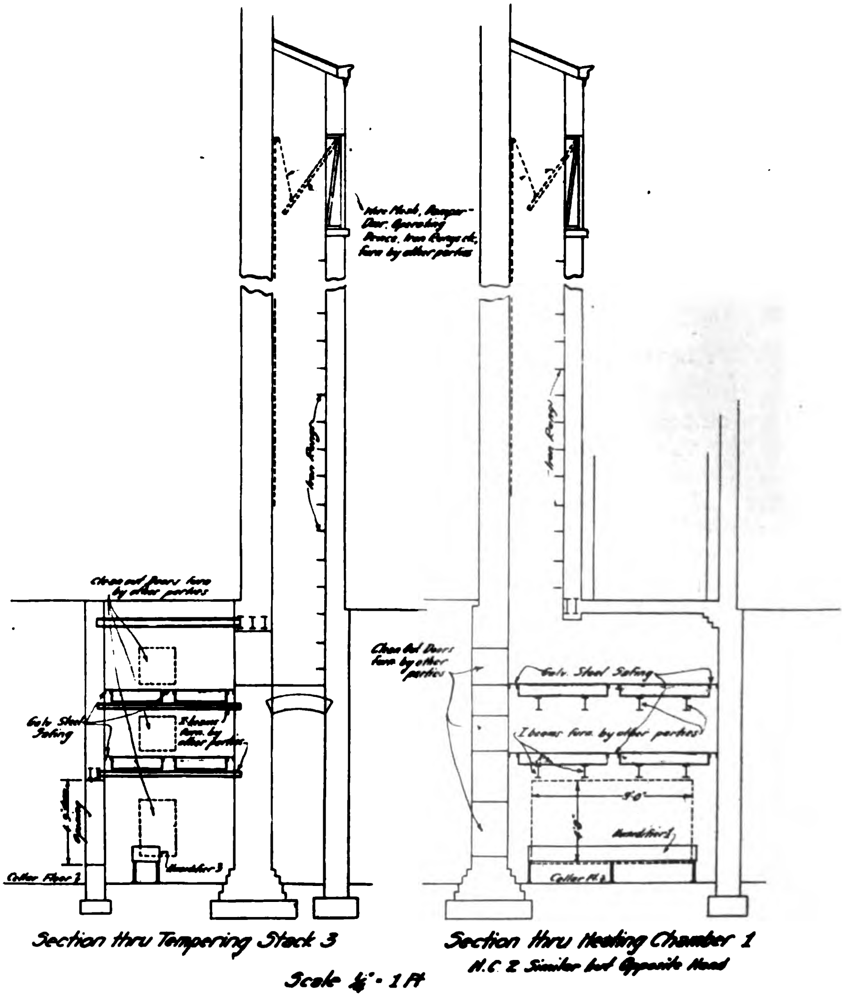

Wire Mesh, Damper Door, Operating Device, Iron Rungs etc. furn by other parties
Iron Rungs
Clean out Doors furn by other parties
Galv Steel Safing
I beams furn. by other parties
Cellar Floor 1
Humidifier 3
Clean Out Doors furn by other parties
Galv. Steel Safing
I beams furn. by other parties
9'0"
Humidifier 1
Cellar Fl. 1
Section thru Tempering Stack 3
Scale ¼" = 1 Ft
Section thru Heating Chamber 1
H.C. 2 Similar but Opposite Hand

FIG. 7—FRESH AIR INTAKE, PUBLIC SCHOOL 62, MANHATTAN.

rooms are always placed about 8 in. below ceiling on an inside wall on opposite side of room from outside windows.

The rate of velocity of flow through such fresh-air inlets averages only between 240 and 275 ft. per minute and the flow is so diffused that the velocity is nearly uniform through all points of the opening. There is, therefore, no tendency to draftiness.

The spent or used air leaves the room through the lower panels of wardrobe partition on same side of the room as fresh-air inlets and extending across nearly the whole width of the seated portion of the room.

The incoming velocity is adequate to force most of the air across the room before it drops to the breathing plane, where it recrosses the room toward the vent outlets driving the used or so-called "vitiated" air into the wardrobe, and then out of the wardrobe through vent outlet in end or top of wardrobe into vent flue leading to roof.

Thermometer tests of rooms with mechanical ventilating system in service, and out of service, have shown that when the plenum system is in service there is not more than one or two degrees difference in temperature in any two points in the occupied space in room from floor to above the head level, whereas in room when ventilated by opening windows there is often as much as 10° difference between points in the same plane (the so-called breathing plane at or near pupils' heads) and there is much more difference between floor and head-height plane.

From this test, and also from CO_2 tests, flash-powder tests, etc., it is evident that with mechanical ventilation all parts of the room get an even supply of fresh air, whereas with open-air ventilation there is no such regularity, to say nothing of the draftiness in case of high winds and of the entire absence of air-movement in muggy or still-air conditions out-of-doors.

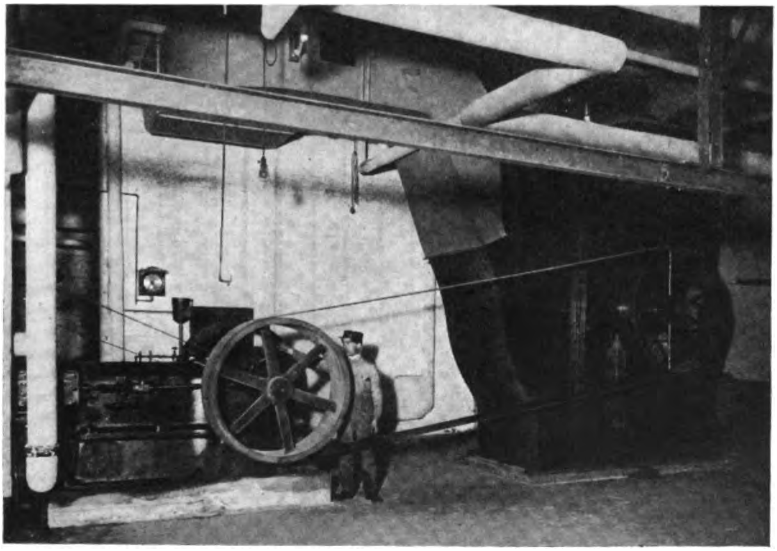


FIG. 5—ENGINE, BLOWER, ETC., PUBLIC SCHOOL 62, MANHATTAN.

In passing through the wardrobes, the spent or used air aerates the outer wraps stored therein and in rainy weather such air dries and deoderizes the wet wraps, thereby serving a needed purifying service. Some may say that the clothing may thus become impregnated with disease germs which have been given off by the pupils, but expert tests have fully demonstrated that such disease germs are not at all likely to be caught by clothing or persons at any considerable distance from the carrier of such germs, and the clothing is much less likely to catch such germs than are the pupils themselves, since the pupils come into direct personal contact with the sick persons.

The vent outlet in end of each wardrobe is made very large so that it cannot be blocked by the hanging of clothing near to or in front of same. The vent flue from each room is extended up separately, as shown in Fig. 9, to the underside of the roof, and directly beneath roof all such vent flues are gathered together into trunk ducts leading to exhaust-fans, as shown in Fig. 10, one for the same rooms as are supplied by a plenum blower, excepting that the vent flues from toilets are connected to separate exhaust-fans, independent of the class-room vents.

The fresh-air supply to toilets is first delivered into corridors and passes out of corridors into toilet rooms through louvres in toilet room doors. The flow of air is therefore always from corridors into toilet and toilet odors cannot escape into corridors or class-rooms.

The vent outlets from toilet rooms are installed near floor, at points closely at rear of each toilet seat, thus removing all odors at the source before they have a chance to be disseminated throughout the room, and the use of an independent exhaust fan for toilet vents permits the thorough ventilation of such rooms at all times whether mechanical ventilation is being provided for the rest of the building or not.

The exhaust or vent fans are installed in pent houses above the roof of building and discharge through suitable ventilator heads as shown in Fig. 10. Such vent fans are electrically driven, since they are too remote from boilers to warrant the use of steam-engines for this purpose.

In smaller buildings exhaust fans are

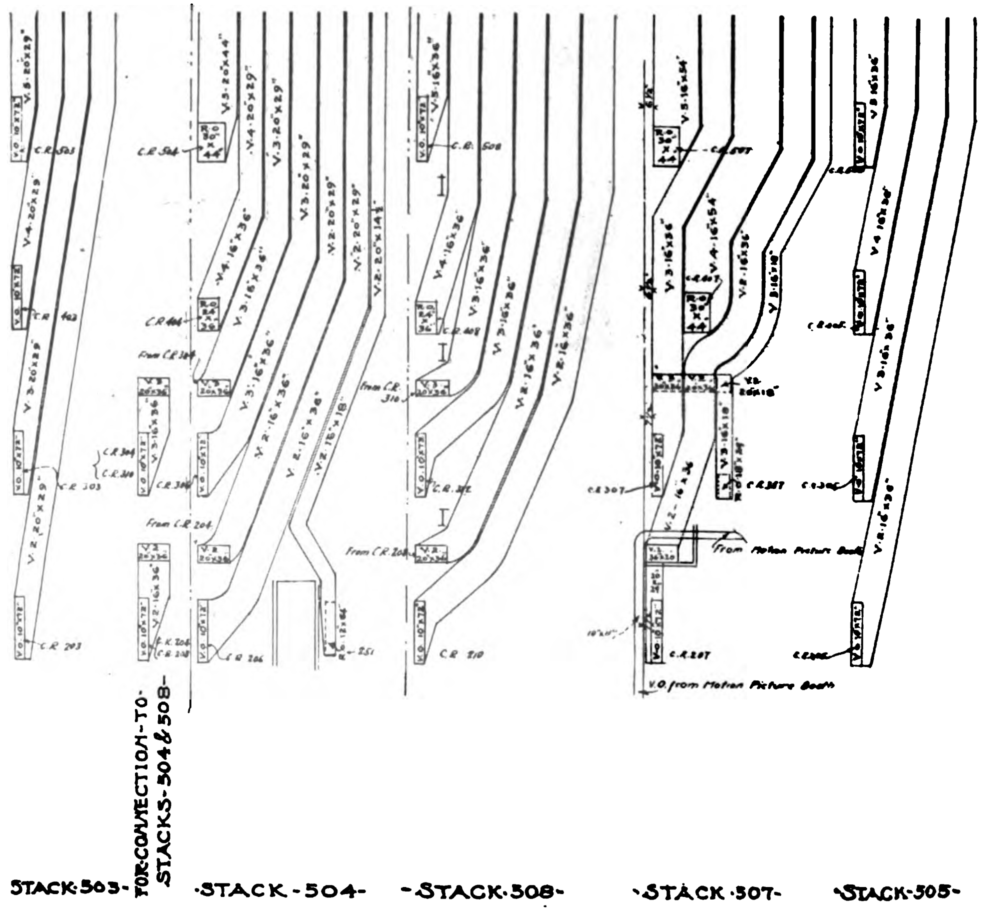
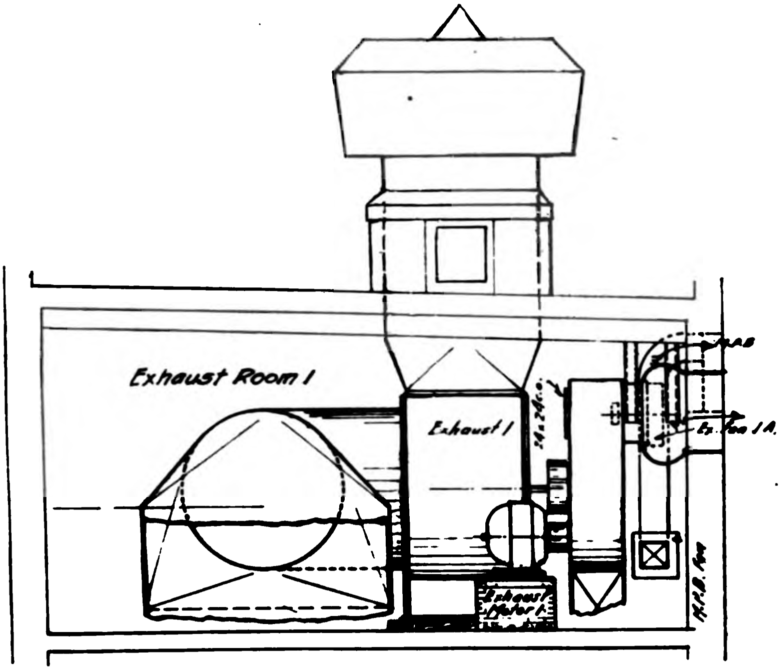
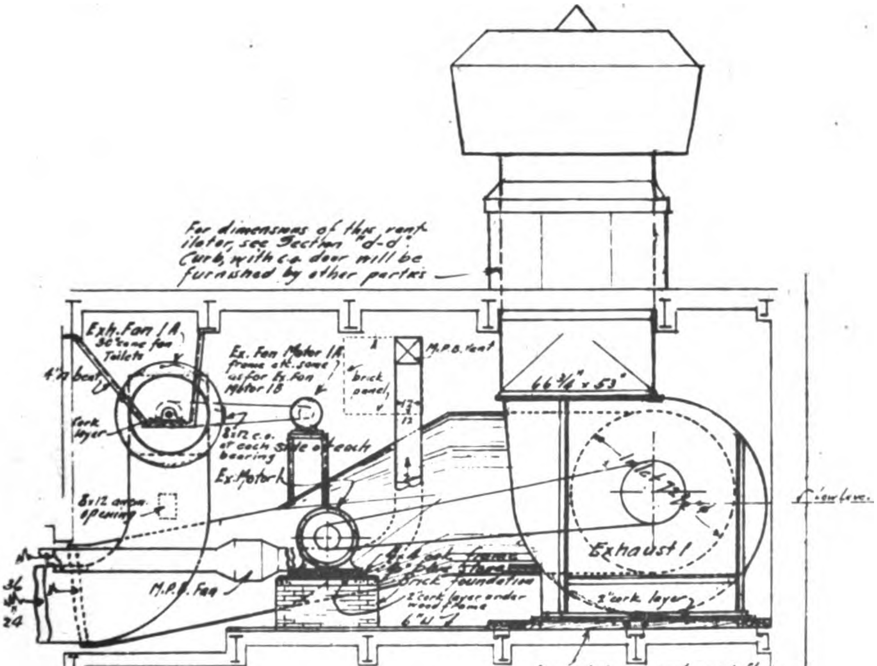


FIG. 9—TYPICAL HEAT AND VENT FLUES FOR PUBLIC SCHOOL 55, THE BRONX.



Section "g-g"
Scale 1/4" = 1 Ft.


For dimensions of this ventilator, see Section "d-d". Curb, with c.o. door will be furnished by other parties
Exh. Fan 1A, 30" cone fan Toilets
4"x4" beat
Cork layer
Ex. Fan Motor 1A frame etc. same as for Ex. Fan Motor 1B
brick panel
M.P.B. Vent
8x12 c.o. at each side of each bearing
Ex. Motor 1
8x12 access opening
66 3/4" x 53"
Exhaust 1
M.P.B. Fan
4x4 oak frame
Brick foundation
2" cork layer under wood frame
2" cork layer
6x12 oak frame anchored to floor beams with hook bolts
36
24
Center line

Section "e-e"
Scale 1/4" = 1 Foot.

FIG. 10—TYPICAL ARRANGEMENT OF VENT FAN AND EXHAUST HEAD.

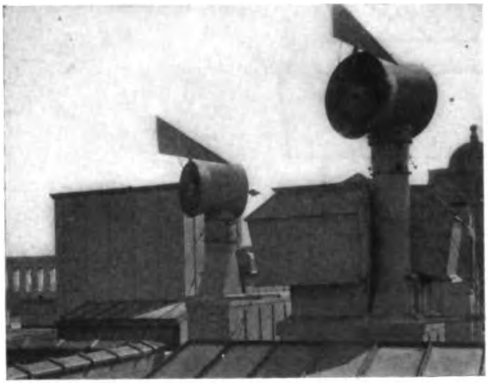


FIG. 11—TYPICAL VENT HEADS USED FOR CLASSROOMS AND ROTATING TYPE HEADS USED FOR TOILETS, WHEN EXHAUST FANS ARE OMITTED.

sometimes omitted and suitable aspirating ventilator heads are used at the top of each tier of vent flues. Fig. 11 is a view taken on the roof of a recent building and shows both the customary stationary vent heads used for class rooms and the rotating type heads used for toilet, when exhaust fans are omitted. The stationary type head here shown is also used to cap exhaust fan discharges, as in this case.

AUDITORIUM HEATING AND VENTILATING.

So far the author has discussed the heating and ventilating of the class rooms and other school rooms, but the auditoriums are treated somewhat differently. Fig. 12 is a photograph of a typical high school auditorium and shows the superb nature of these rooms. The ventilating and heating of these rooms are accomplished in a manner that is inconspicuous, although effective. The auditorium is provided with fresh air supply in the same way as the class rooms. Much of this fresh air supply enters the room through registers forming the window sills in front of windows as shown in Fig. 13. The fresh air supply for the auditorium is heated to the temperature necessary to replace the heat lost from the room through walls, windows, skylights, etc., and the warm air entering beneath the windows and rising in front of the windows so blankets these sources of cold that the seats near the windows are as comfortable as those in the center of the room.

It is not necessary to overheat the fresh air supply in order thus to warm the auditorium, as it is never necessary to have this air heated above 90° F. and it rarely exceeds 80° F.

One-third of the air supply enters below the gallery and two-thirds of the air enters through side walls above the gallery in a room of this type. For a single-story auditorium each window is blanketed by fresh air as above noted and only such additional air as is necessary is brought in through side wall registers near ceilings.

The vent outlets in most cases are in floors of aisles, but in the best arrangements there is a hollow leg to each seat and the vent outlet is through such hollow legs into a vent chamber underneath the floor.

The regular heaters warming the fresh air supplied to auditorium heat same only to 55° or 60° F. and the reheaters add enough heat to the air to maintain the room at a comfortable temperature. The reheaters are broken up into relatively small groups and each such group is automatically controlled by a room thermostat, located in the portion of auditorium supplied by respective reheater.

RECIRCULATION.

In order to conserve fuel, a system of dampers and cross-connecting ducts is so arranged that when the auditorium is unoccupied the air used to convey heat to the auditorium may be taken from the vent ducts, thus enabling the heating of the auditorium during periods of non-occupancy, by recirculation of the room

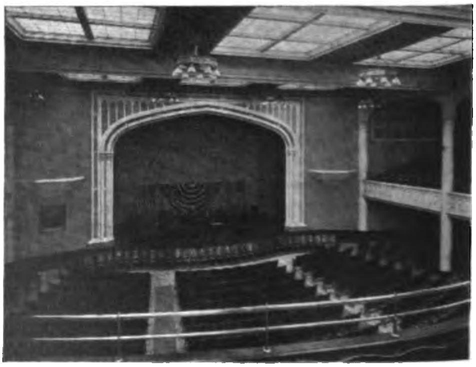


FIG. 12—AUDITORIUM, BUSHWICK HIGH SCHOOL, BROOKLYN.

air. This conserves the heat which would otherwise be carried away in the outgoing vent air and also avoids the use of the heat which would be required to bring the outdoor air up to vent-duct temperature. The reheating stacks alone, as a rule, are thus sufficient to warm the recirculated air enough to maintain a proper temperature in the unoccupied auditorium.

The attention of the attendant is forcibly drawn to the necessity for reversing the dampers and drawing from out-of-doors for ventilating of auditorium during occupancy, by means of suitable instruction plates fastened to engine throttle-valve and to motor-starting device. The throw-over dampers are operated by air-pressure from the riser-control board. (Fig. 5.)

MINOR DETAILS.

Thermometers are placed in each room in addition to thermostats, so that the room temperatures can be readily observed by occupants. Thermostats have locked covers so that unauthorized persons cannot adjust or tamper with same. Thermostats also have covers of such character that thermostat movements cannot be operated, or prevented from operating, by means of pins, flag sticks, etc., with which teachers sometimes thoughtlessly attempt to attach decorations to such covers.

All risers passing through classrooms, etc., are covered with three plys of heavy asbestos air-cell covering wired on, and are then encased from floor to ceiling in neatly formed sheet-metal casings, so that covering will not be destroyed.

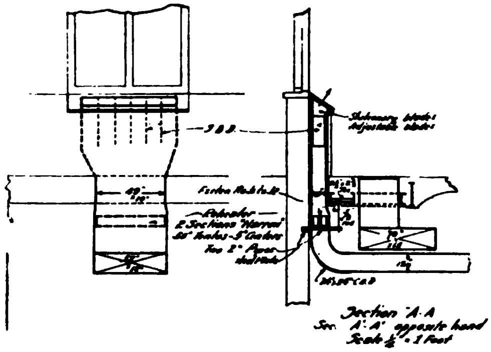
When exhaust-fans are omitted and ordinary ventilator heads are used over vent flues, dampers are placed in the base of each such ventilator head, and such dampers generally are operated by air-pressure from riser-control board, thus making it easy for the janitor to open and shut dampers in vent heads.

AIR-WASHERS.

While firmly believing in the efficacy and desirability of washing the air supplied for ventilating, we have rarely installed air-washers because insufficiency of funds has prevented same. In a few very dusty neighborhoods air-washers have been installed and the quantity of dirt removed by them from the air, being at least six 10-quart pails per one week from one such washer, is eloquent of their value.

BOILER-PLANT, ETC.

In the ordinary school of more than 16 class-rooms, steam-boilers designed to carry 100 lbs. working pressure are installed, but they are run at about 60 to 70 lbs. working pressure. This permits the boilers to be safely used at the normal pressure for practically the life of



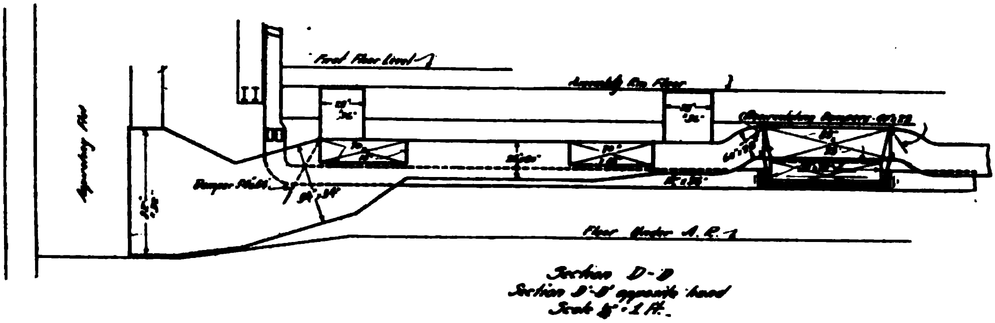


FIG. 13—FRESH AIR INLET UNDER AUDITORIUM WINDOW.

the boilers, which is often as long as 30 years.

Horizontal-tubular brick-set boilers have been used in most cases until within the last few years, although boilers of other types have been tried out as occasion warranted. (Fig. 14.)

While water-tube boilers have some advantages, they are more costly to install (in some units suitable for schools) and take more head-room than fire-tubular boilers, and under the peculiar service conditions of schoolhouse heating, they have not proven worth while.

There are now generally used boilers of an internally-fired return-tubular type, shown in Fig. 15, which have no brickwork to maintain and cost no more to install than the older brick-set horizontal-tubular bodies.

As nearly all the condensed exhaust steam is freed from oil and returned to the boilers, little fresh water is needed and the boilers do not form scale to any extent, even though no boiler compound is used. There is, therefore, no difficulty experienced with scale causing burned-out water-legs.

Forced draft of the under-grate turbo-blower type is being used on the boilers and a mixture of about 80 per cent. No. 3 buckwheat anthracite coal and the rest a good grade of semi-bituminous coal is being burned.

The grates have ⅛-in. air-spaces, and the draft pressure in ash-pit varies from nothing up to about 1½ in., water gauge. The use of this mixture has resulted in marked economy in cost of fuel over other fuels.

The boilers are equipped with high and low water alarms, low-water detectors, boiler water line regulators, soot blowers, safety valves, boiler feed-pumps, feed-water heater, etc., as is usual in ordinary power plants of good quality.

HEATING MAINS, ETC.

The steam run-out from each boiler is a section of 12-in. pipe with a straight-size 12-in. elbow, bushed in the sand to size of regular run-out, at top of same. By this means is obtained very slow flow of steam from boiler and no water is lifted over into steam-mains even though no steam-separator is used in boilers. This device has been found very much more efficient than steam-separators placed inside of boilers.

From the main high-pressure steam-header at boilers, connections are taken to steam-engines driving ventilation-system blowers, forced-draft blowers,

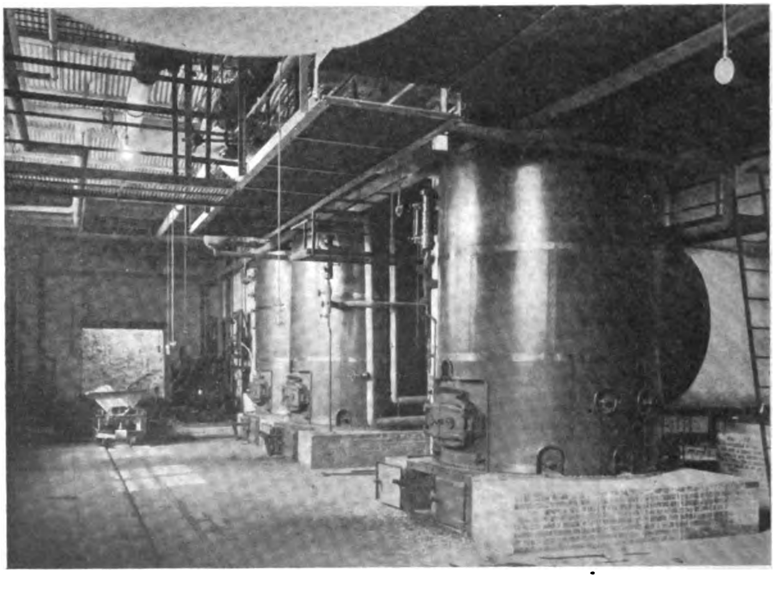


FIG. 14—BOILERS, BUSHWICK HIGH SCHOOL, BROOKLYN.

steam-pumps, etc., and each branch line is valved close up to header. From this high-pressure header (carrying 60 to 80 lbs. steam pressure) live steam, at reduced pressure, is also taken for use in the heating system, but only when the exhaust steam from blower engines, forced-draft outfits, pumps, etc., is inadequate to heat the building.

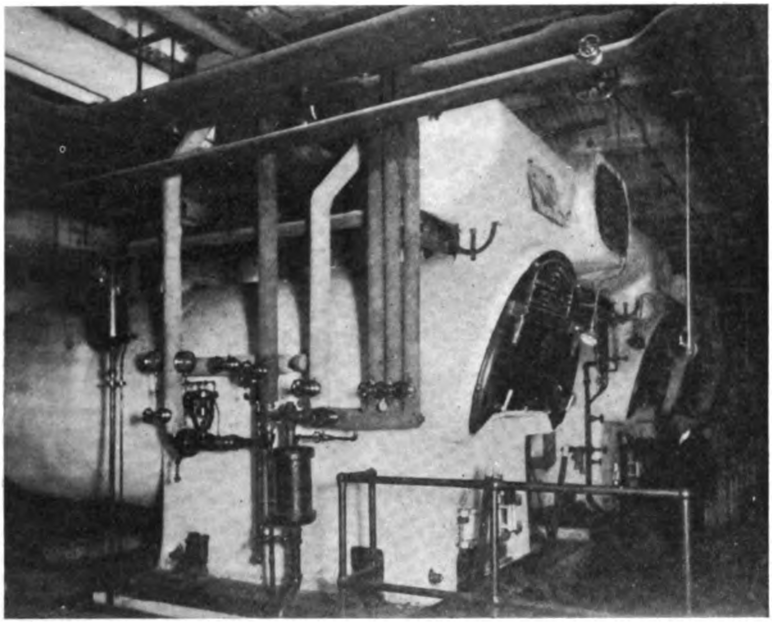


FIG. 15—INTERNALLY-FIRED, RETURN TUBULAR TYPE OF BOILER GENERALLY USED.

A back-pressure of 3 to 9 lbs. is maintained on the exhaust-lines whenever heat is needed, the greater pressure only being used in very cold weather, when all the exhaust-steam thus available is needed for heating.

The exhaust-steam used in the heating system is all purified by means of a large grease-extractor muffler combination, but the excess exhaust escapes to the atmosphere without passing through the grease-extractor. There is no by-pass around the grease-extractor and it is therefore impossible to turn unpurified exhaust-steam into the heating system or to get same back into the boilers.

When the heating system requires more heat than the exhaust-steam with back-pressure valve set at 9 lbs. can supply, then live steam from boiler-header is added in the following manner: (Fig. 16.)

Two pressure-reducing valves, each capable of providing steam for one-half the total heating load, are provided and so installed and adjusted that one will supply steam at 8 lbs. pressure so long as this supply and the exhaust together are adequate to carry the heating load, and the second reducing-valve will open us only when the line pressure in heating main drops to 7 lbs. or less in spite of the first reducing-valve and the exhaust supply.

By this arrangement the reducing-valves do not wire-draw or cut their seats to cause leakage, and close regulation and economical use of live steam is effected.

The exhaust and reduced boiler-pressure together thus maintain about 7 to 9 lbs. pressure on this heating main in cold weather, when the exhaust is insufficient alone, but in mild weather these reducing-valves are closed off and the exhaust or back-pressure is reduced to as low a pressure as the lessened need for heat will permit.

The indirect heaters used as tempering stacks and reheaters for the ventilating system are supplied with steam directly from this heating main, as a pressure of 6 or 8 lbs. is necessary to drive the steam into large groups of these indirect heaters, such as are used in blower systems, in sufficient quantity to keep the entire heater hot in cold weather.

On the other hand, a pressure of 1 to 2 lbs. is ample to thoroughly heat up the direct radiators in the class-rooms, etc., and a pressure in excess of 2 lbs. is objectionable because of noisy operation of radiators, too-quick filling of radiators when thermostats open steam-valves on radiators, greater risk to pupils in case of broken radiators, etc.

Therefore, the steam-pressure is again reduced from that carried on the indirect heaters to about 1 or 2 lbs. before admitting it to the steam-mains supplying direct radiation.

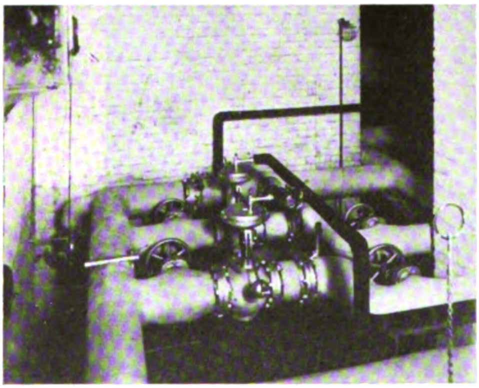


FIG. 16—ARRANGEMENT FOR AUTOMATICALLY SUPPLEMENTING LIVE STEAM TO EXHAUST STEAM SUPPLY.

For the same reasons as given in the case of the first reducing-valve combination, two small reducing-valves are used for this service, arranged one to open when reduced-line pressure falls below 1½ or 2 lbs., and the other when this pressure falls to about 1 lb.

By this combination of two heating pressures and two reducing-valves in each reducing combination, there are obtained practically noiseless operation, long life to valves, close regulation, continuous service and very satisfactory results in the heating system.

In order that no accident may occur in case a reducing-valve should stick open, a pop safety-valve is placed in each heating main on the low-pressure side of respective pair of reducing-valves.

PIPE COVERING, ETC.

The boilers are covered directly onto the shells with 1-in. asbestos blocks, wired on with chicken-wire netting, over which there is applied 1 in. of asbestos cement with hard finish.

The smoke-pipes, receiving tank, blow-off tank, large trap bodies and feed-water heater are similarly covered, with 1 in. air-space between surface of tank and blocks. All steam, exhaust, heating and hot-water lines are covered with standard asbestos covering neatly finished with 8-oz. canvas sewed on, except where such pipes are boxed in, in which case the canvas is omitted.

All ducts through boiler-rooms are wrapped with asbestos air-cell and canvas to prevent noise from plant being carried into class-rooms or auditoriums. In coal bins the ducts are covered also but the canvas is replaced by sheet iron flanged to ceilings (or side walls) to prevent coal from lodging on top of ducts or breaking same down.

All canvas on covering is painted to keep the dampness from spoiling covering; and the painting on pipe-lines is of colors to agree with a color chart, so that a strange engineer taking hold of the plant need have no difficulty in easily determining what each line carries.

In this connection each valve around boilers, engines, indirect heaters, etc., is also tagged with an easily readable number, and a valve sheet showing the location and purpose of each such valve is framed under glass, as is also the color chart, and mounted on wall at some point convenient to the fireman and engineer.

Sufficient tools are given the janitor to enable him to make most of the necessary minor repairs around the plant. Guard-rails and ample lights safeguard each moving part of plant and so far as possible safety and ease of operation have been provided.

Best Position For a Radiator in a Room

(Report presented at the semi-annual meeting of the American Society of Heating and Ventilating Engineers, in Detroit, Mich., July 19-21, 1916.)

The tests reported herein were conducted in the Mechanical Laboratory of the University of Michigan by Professor J. E. Emswiler, in charge of the experimental laboratory. They were made in Room 244 of the New Engineering Building, which is a room 22 by 26 ft., with the west wall exposed. Fig. 1 gives the principal dimensions.

A steel radiator was used which had welded joints, and 48 sq. ft. of rated surface. It consists of 12 sections 8¼ in. in width by 33 in. in height, and was provided with rubber hose connections to the steam supply, also to the drain and by-pass. The steam upon passing through a valve on the steam supply line entered the rubber hose leading to the radiator. On the steam inlet side of the radiator were placed a separator with a by-pass, a valve for controlling the pressure, and also a pressure gage. There was also on the steam inlet side of the radiator, an orifice to insure a slight superheat and a thermometer for obtaining the temperature of the steam entering the radiators. A U-tube was placed near the top on the return side of the radiator for obtaining the pressure in the radiator.

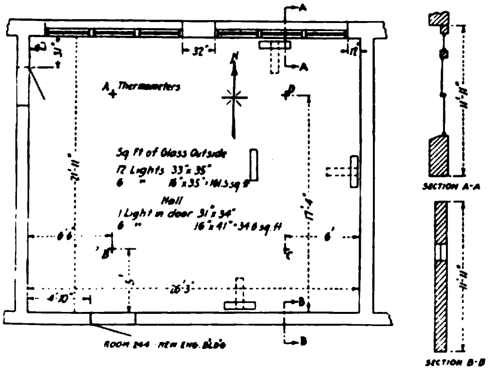


FIG. 1—ROOM IN WHICH TESTS WERE CONDUCTED.

The return connections consisted of a receiver provided with a glass tube for noting the level of the water in the receiver, which level was kept at the same point when securing results. A pet cock was placed on top of the receiver, through which a small amount of steam was allowed to flow at all times, thus keeping the radiator free of air. The condensation was taken off at the bottom of the receiver through a valve and rubber hose connection to a weighing scales and weighed. Readings were taken at ten minute intervals, the tests on the average lasting an hour. To be sure that the radiator was free from air, a thermometer was placed between the radia-

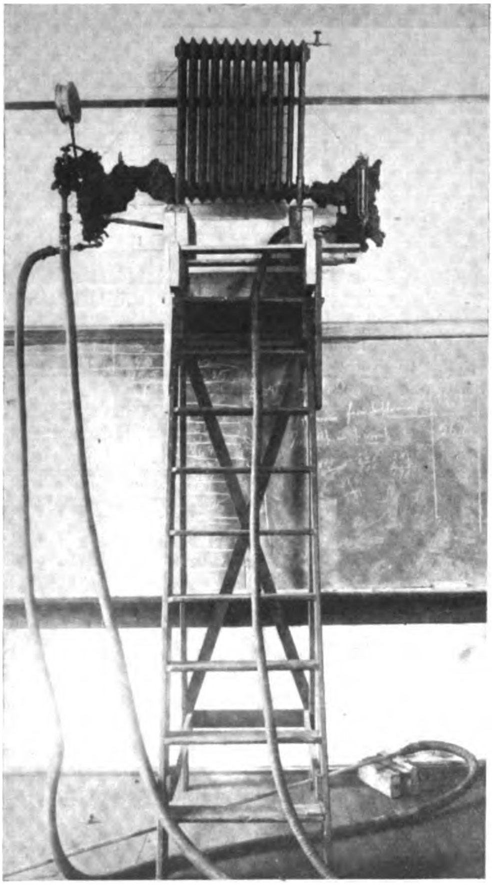


FIG. 2—ARRANGEMENT OF RADIATOR FOR TESTING IN ELEVATED POSITION.

TABLE 1—RESULTS OF THE 22 TESTS MADE WITH THE RADIATOR IN TEN DIFFERENT POSITIONS.

Test	Location of Radiator			Average Temperatures									
No.	Wall	Floor or Ceiling	Perpendicular or Parallel	Outside	Inside	A	B	C	D	Max. Temp. Range	Lb. Steam per 10 min.	B.T.U. per Hour	Value of "K"
27	West	Floor	Par.	20.4	69.8	68.7	69.6	70.3	70.8	2.1	1.815	10553	1.525
28	West	Floor	Perp.	18.3	70.5	69.4	70.3	71.1	71.4	2.0	1.990	11565	1.670
29	North	Floor	Perp.	16.6	70.4	69.1	70.0	72.0	70.7	2.9	1.942	11284	1.630
30	North	Floor	Par.	15.2	69.4	68.0	69.3	70.4	70.0	2.4	1.941	11284	1.620
31	East	Floor	Par.	12.9	69.2	67.6	69.7	70.7	69.0	3.1	1.968	11439	1.640
32	East	Floor	Perp.	11.4	69.3	67.7	69.7	70.9	68.8	3.2	2.000	11623	1.665
33	Center	Floor	East & West	10.6	69.0	67.7	69.1	69.7	69.4	2.0	2.034	11817	1.690
34	East	Ceiling	Par.	10.0	65.5	64.3	65.9	66.9	64.8	2.6	2.110	12262	1.710
35	North	Ceiling	Par.	10.5	64,0	64.0	65.6	64.4	66.2	2.2	2.105	12230	1.700
36	North	Ceiling	Par.	15.0	67.4	68.4	67.0	67.8	66.4	2.0	1.988	11550	1.633
37	East	Ceiling	Par.	13.1	67.7	66.5	67.8	69.3	67.1	2.8	2.087	12128	1.720
38	Center	Floor	East & West	13.1	69.7	68.6	70.1	70.8	69.3	2.2	2.184	12694	1.829
39	East	Floor	Par.	15.5	69.7	68.2	70.1	71.1	69.8	2.9	2.115	12269	1.730
40	North	Floor	Par.	16.4	70.5	68.9	70.6	71.9	70.7	3.0	2.116	12286	1.759
41	North	Floor	Perp.	18.0	71.4	70.6	72.3	72.4	72.4	1.8	2.105	12220	1.756
42	East	Floor	Perp.	20.8	75.6	74.8	75.1	76.9	75.7	2.1	2.082	12064	1.753
43	West	Floor	Par.	23.9	78.0	77.1	77.8	78.4	78.7	1.6	2.056	11898	1.730
44	West	Floor	Perp.	26.3	79.0	77.7	78.8	79.2	80.1	2.4	2.060	11935	1.770
45	West	Floor	Par.	32.8	77.1	75.5	76.5	76.9	78.9	3.4	1.704	9943	1.510
46	Center	Ceiling	East & West	29.4	73.8	72.6	73.7	75.0	73.8	2.4	1.750	10177	1.510
47	East	Ceiling	Par.	26.7	73.5	72.4	73.7	75.0	73.0	2.6	1.667	9695	1.440
48	North	Ceiling	Par.	27.2	73.8	72.6	74.0	74.6	73.8	2.0	1.684	9794	1.460

TABLE 2—AVERAGES OF THE RESULTS OF TESTS WITH RADIATOR IN TEN DIFFERENT POSITIONS.

Test	Location of Radiator			Average Temperatures										
No.	Wall	Floor or Ceiling	Perpendicular or Parallel	Outside	Inside	A	B	C	D	Max. Temp. Range	Lb. Steam per 10 min.	B.T.U. per Hour	Value of "K"	B.T.U. per Hour per deg diff. Air
27 43 45	West	Floor	Par	25.7	75.0	73.8	74.6	75.2	76.1	2.3	1.858	10798	1.588	219
28 44	West	Floor	Perp.	22.3	74.5	73.6	74.6	75.2	75.8	2.2	2.025	11750	1.720	224
29 41	North	Floor	Perp	17.3	70.9	69.8	71,2	72.2	71.6	2.4	2.024	11752	1.693	219
30 40	North	Floor	Par	15.8	70.0	68.5	70.0	71.2	70.4	2.7	2.028	11785	1.700	217
35 36 48	North	Ceiling	Par	17.6	68.3	68.3	68.9	68.9	68.8	0 6	1.926	11191	1.598	220
31 39	East	Floor	Par	14.2	69.4	67.9	69.9	70.9	69.1	3.0	2.042	11854	1.685	215
32 42	East	Floor	Perp.	16.1	72.4	71.2	72.4	73.9	72.2	2.7	2.041	11844	1.709	210
34 37 47	East	Ceiling	Par	16.6	68.9	67.7	69.1	70.4	68.3	2.7	1.955	11362	1.623	217
33 38	Center	Floor	East & West	11.8	69.4	68.2	69.6	70.2	69.4	2.0	2.109	12256	1.760	213
46	Center	Ceiling	East & West	29.4	73.8	72.6	73.7	75.0	73.8	2.4	1.750	10177	1.510	229

tor and the receiver, thus giving a temperature check on the steam in the return. Fig. 2 shows the radiator in an elevated position preparatory to a test.

Twenty-two sets of tests were made between February 12th and 26th, 1916, with the radiator in ten different locations, seven on the floor and three elevated. Table 1 gives results obtained from these tests. Table 2 is obtained by averaging the results given in Table 1 for the ten different locations. Curves were plotted showing room temperature average, outside temperature and weight of condensed steam at ten minute intervals. The results obtained are quite consistent. They cover not an unusual range in values as will be noted from the following, taken from results as shown in Table 1:

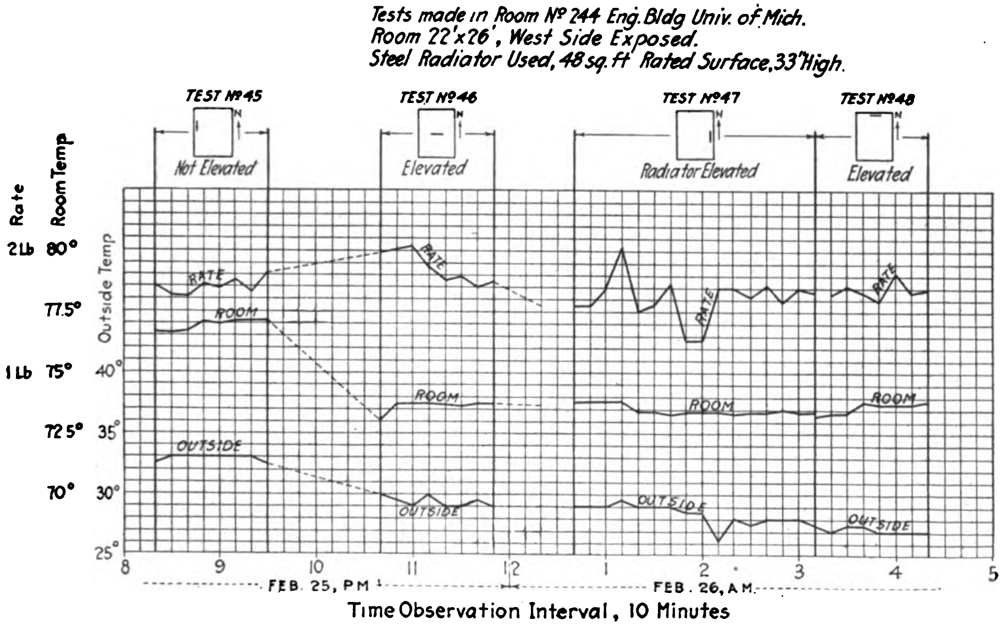


FIG. 3—CURVES SHOWING ROOM TEMPERATURES, OUTSIDE TEMPERATURES AND WEIGHTS OF CONDENSED STEAM PER 10 MIN. FOR RADIATOR IN DIFFERENT POSITIONS AND LOCATIONS IN ROOM.

Outside Temperature, deg. F..	10.0 to 32.8
Inside Temperature, deg. F...	64.0 to 79.0
Maximum Temperature Range in Room, deg. F..........	1.6 to 3.4
Value of *K* (B.T.U. per sq. ft. per hour per degree of difference)	1.44 to 1.829

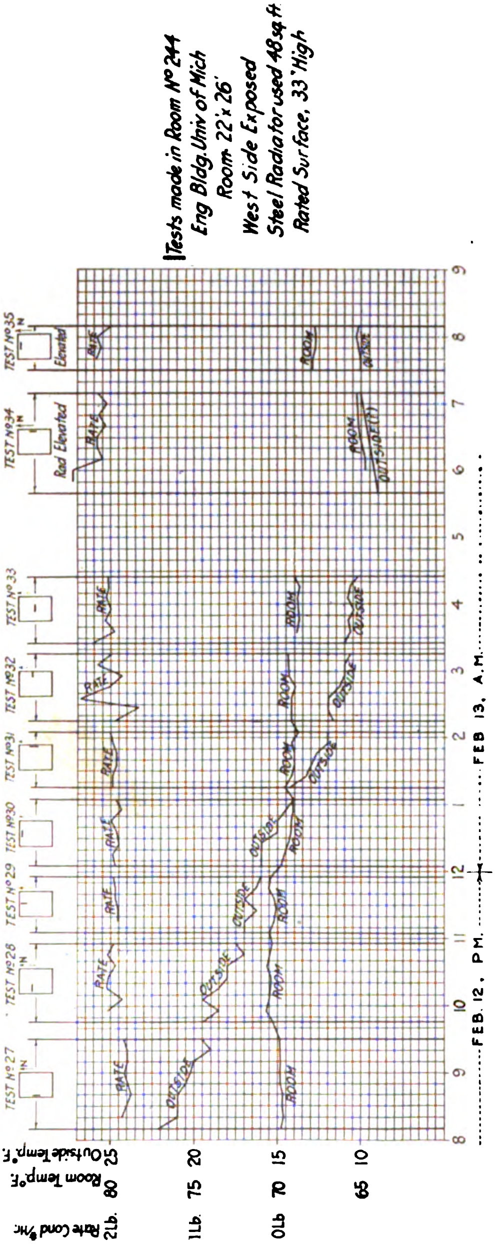
In averaging the results for the ten different positions the range is not so marked:

Outside Temperature, deg. F.	11.8 to 29.4
Inside Temperature, deg. F..	68.3 to 75.0
Maximum Temperature Range in Room, deg. F..........	0.6 to 3.0
Value of *K*	1.510 to 1.760
B.T.U. per hour per degree of difference inside and outside air.	210 to 229

The greatest value of *K* 1.760, is obtained when the radiator is placed in the center of the room (see Table 2). This indicates that more B. T. U. are secured per square foot per degree difference between the steam in the radiator and the average temperature of the room, in this position than in any other. The temperature range indicated by the four thermometers, 2.0°, is next to the smallest and it will be noted that the B. T. U. given up by the radiator 213 B. T. U. per degree difference, is below the average. This last, however, may be due to other causes, such as varying wind conditions outside.

With the radiator placed in the usual position, parallel to the wall and under the exposed glass surface, the value of *K* is 1.588, the maximum temperature range in the room is 2.3° and the B. T. U. per degree difference given up by the radiator is 219 B. T. U. 1.51 is the lowest value of *K*, which was obtained with the

Tests made in Room No 244
Eng Bldg. Univ of Mich
Room 22' x 26'
West Side Exposed
Steel Radiator used 48 sq ft
Rated Surface, 33" High



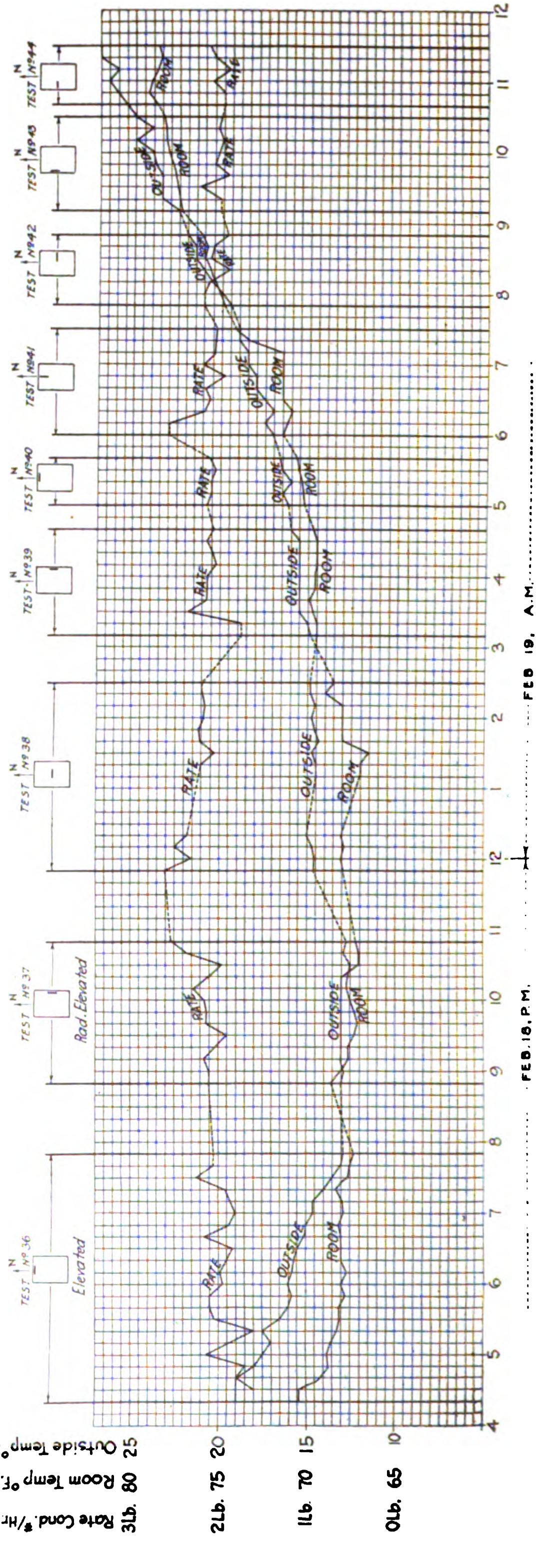


FIG. 4—CURVES SHOWING ROOM TEMPERATURES AND WEIGHTS OF CONDENSED STEAM PER 10 MIN. FOR RADIATOR IN DIFFERENT POSITIONS AND LOCATIONS IN ROOM (Continued).

radiator elevated in the center of the room. The corresponding value of the B. T. U. per hour per degree difference of outside air and inside air is 229, which is a maximum for the different positions.

The report was submitted by W. F. Verner, Chairman; J. R. Allen and R. Collamore.

The Fee-Plus-Cost System of Charging for Professional Service.

Plan Proposed for Architects That Could Be Easily Adapted for Engineers

By WILLIAM STANLEY PARKER.

Vice-Chairman of the Committee on Contracts and Specifications, A. I. A., and Published in the Journal of the American Institute of Architects for May, 1916.

A. THE PERCENTAGE SYSTEM.

The system of charging a certain percentage of the final cost of the work for the architect's services has become a firmly established custom. The strongest reason for this is that, by establishing a customary percentage, competition between architects on a basis of size of fee can be eliminated, and this must continue to be eliminated so that professional qualifications may alone form the basis of comparison.

As a matter of fact, this appears to be about the only legitimate reason for the creation of such a system, the other reasons that now exist being the result of the system, not precedent to it; as, for instance, the reasons most often given by an architect being that he has always used it and that other architects generally use it and therefore that owners are familiar with it and that it is recognized in the courts, in other words, that it is customary.

B. DEFECTS IN PERCENTAGE SYSTEM.

There are many defects, however, that are inherent in such a system of charging for the professional services of an architect.

A customary percentage for all architects assumes an equality of professional ability which obviously does not exist. In addition to this, the net profit which it is intended shall accrue to the architect for his professional service is dependent on many elements in the work over which he has little or no control, and which vary according to the work and the personality of the owner.

The variation in draughting costs can be very great and can easily eat up most, if not all, of the contemplated profit. Architects often confess to doing residences at 6 per cent, at a loss, making up for it by profits on commercial work. This of course is not a business proposition. Each client should pay the legitimate expenses connected with his work and a reasonable profit for the personal services of the architect.

To a certain extent changes are made during the progress of any work. Frequently these are aggravated in number and in resulting expense to the architect, solely as a result of the client's attitude toward the work and yet without exceeding the legitimate duties of the architect. In such cases the burden of personal service of the architect is increased and his profit is not increased but is steadily reduced, not only through increased draughting costs but in many cases because the change is made to reduce the cost of the work and this automatically reduces the compensation.

C. RECOGNITION OF THE DEFECTS.

Architects recognize and partially correct these defects in the system by charging different percentages for different types of work. In determining these different percentages the architect must consider the varying amount of personal service involved and the probable average cost of draughting required in the different types of work, and then set percentages that will be generally adequate. He may for instance have three different rates, one for lofts, warehouses, and similar buildings, one for miscellaneous public and private work, and one for residences; or he may have other classifications to suit his own practice.

D. FEE-PLUS-COST SYSTEM.

A system under which the architect charges a professional fee for his personal service, and in addition charges his various expenses at cost, is growing in favor, as it is both logical and flexible. When the study of a problem is started, an agreement is reached with the owner by which the architect is to receive a definite, guaranteed sum as his professional fee. Since this is guaranteed, it can reasonably be reduced to a minimum. The draughting and other expenses being charged at cost, the expense of all changes in the drawings is automatically taken care of. An owner who makes few changes will have a correspondingly small draughting charge to pay, and vice versa. The owner may fear that the draughting will not be done economically and his expense be thereby increased; but, if the owner is willing to trust his architect to administer the expenditure of say $100,000 for the material and labor on the work, surely he should be willing to trust the architect to administer the expenditure of from 1 per cent to 2 per cent of that amount to draughting. Moreover, if the architect's personal profit is independent of the cost of the work, the owner may well feel easier about the disinterested administration of his funds. While it is by no means a fact that architects deliberately "pad" the cost of the building by use of unduly expensive materials or methods, still under the percentage system they do benefit by such use and it is not to be wondered at if they, to a greater or less extent, adopt an attitude of passive acquiescence in expenses suggested by the owner or thoughtlessly included in the development of the problem. With his professional fee guaranteed, the architect is stimulated to devote his best endeavor to the interests of his client, whether it be in an effort to reduce the cost of the work, which an owner generally desires, or to perfect details of equipment. Also the owner does not have the somewhat galling reflection, when trouble occurs and extras are incurred, that he is paying the architect a commission on what he may consider to be the architect's mistakes.

It is generally acknowledged that the more complete the plans the lower the estimates will be. Under the percentage system this economy in estimates must be obtained at an expense in draughting that reduces the element of profit to the architect. Under the "Fee-Plus-Cost" system the architect is free to make the complete drawings that the work warrants at the expense of the client, who is repaid for this expense in a logical way, by the reduction in the estimates.

In any event, under the percentage system there are a number of items of expense that are customarily charged at cost, such as engineers' fees, clerk-of-the-works and incidental expenses. The "Fee-Plus-Cost" System merely goes one step further and adds at cost the expenses of draughting and overhead in the architect's office, and then adds to the total of these various items of cost a fixed item for professional fee.

It will be readily seen how adaptable this system is to all classes and conditions of service. A piece of work can be analyzed fairly accurately at the start, as to the degree of personal service involved, and a sum named as a fee that is mutually satisfactory, without any regard to the variable elements of expense involved in such service. These elements of expense, just as the larger item of actual cost of the work, can be estimated and reported upon for the information of the owner; but there is no reason why the architect should guarantee what the draughting will cost, any more than he should guarantee what the building itself will cost.

The adaptability of the system to the work of public, private and corporate owners has been demonstrated in actual practice for ten years.

E. DETERMINATION OF FEE.

Just as an average commission on the percentage basis is said to be 6 per cent, so an average fee on the "Fee-Plus-Cost" System might be said to be 3 per cent. It is fairly generally established that an architect's expenses on all classes of work will average half his commission, that frequently they will exceed it, and that if they are less than half it is looked upon as a piece of good fortune. In certain types of work, however, the expenses will be regularly less and in others regularly more than half the commission.

The fee, however, should be determined directly by the personal service required, and not indirectly by the incidental elements of cost involved in performing the service.

In determining the fee, therefore, for each piece of the work, the architect should consider the intensity of personal service required of him, the length of time during which such service is to be rendered, and the responsibility involved in such service, which last element has a certain relation to the financial investment involved in the undertaking of the owner. The sort of service demanded in connection with a large private residence will manifestly be greater, in proportion to the expenditure involved, than that in connection with a warehouse.

Each architect must adopt his own individual scale by which to determine his fees, but it may reasonably be considered that 3 per cent of the cost of the work will represent a mean, the fee being greater or less than 3 per cent according to the demands of the service to be rendered, and always taking into consideration also that the amount of the fee is guaranteed and need not be increased to take care of any uncertain expense items, as in the percentage system, but rather can be reduced to the reasonable minimum.

It is also to be constantly borne in mind that while the fee has been determined in connection with an estimated cost of the work, it is not to be affected by any difference between this estimate and the actual final cost of the work. If the scope of the work is changed so as materially to increase or diminish the intensity, duration, or responsibility of service, then the agreement with the owner should be modified to fit the new conditions. If the conditions of service remain unchanged the fee remains unaffected by the actual final cost of the work.

F. DRAUGHTING.

The cost of the draughting, that is, the net cost of the salaries of draughtsmen engaged on a piece of work, will vary according to office organization as well as according to the character of the work. It can only be estimated by each architect for himself in the light of his own experience. It will probably be found to average from 1 per cent to 2 per cent, with exceptions both above and below these averages.

Charges for draughting by the architect himself should not be made under this item. The fee is for the personal service of the architect. If it is his custom to do a considerable amount of draughting, or if a particular piece of work will involve an unusual amount of his own time for original design or detailing, the fee should be accordingly increased. It is not proper under this system for the architect to obtain profit otherwise than from his professional fee.

The cost of draughting should include the cost of writing specifications and also the cost of inspection by members of the office force other than the architect himself.

G. COSTS.

There are two kinds of cost-items, in addition to draughting, connected with the expenses of an architect's office:

(1) Those items easily chargeable directly to a particular piece of work, such as travel, long-distance telephoning, blueprinting, models, engineers, or clerk of works. These should be so charged.

(2) Overhead costs not easily apportioned:

These overhead costs, such as rent, light, heat, stenography, supplies and postage, have a certain logical relation to the total cost of draughtsmen's salaries, which relation will differ in different offices, but in each will remain fairly constant. Each office should determine this relation and in charging the draughting to each job, add a fixed percentage to cover the overhead charges. In an average office the overhead charges will probably approximate 100 per cent. of the draughting. If the architect as a general rule does most of his draughting himself, under the item of professional fee, as noted above, the overhead charges may very likely be more than the cost of the remaining draughting.

H. RENDERING OF ACCOUNTS.

Under this system accounts should be rendered monthly, each statement covering a payment on account of the fee, and reimbursement of costs incurred during the previous month. The various items of cost offer no problems. Payments on account of the fee need to be predetermined.

Having settled the fee, it is well for the sense of security of the owner to set aside a sum, reasonably about 20 per cent. of the fee, to be paid on the issuance of the final certificate. The balance of the fee should reasonably be paid in monthly installments during the progress of the work.

Under the percentage system it has been customary to make a first payment of 20 per cent. of the estimated commission on completion of preliminary studies, 40 per cent. on completion of working drawings, and the balance as certificates are issued, which is generally monthly. These payments are related to the progress of draughting and, while customary under the percentage system, have no logical basis that warrants their adoption under the "Fee-Plus-Cost" System. The draughting charges, like all other charges for current expenses, are reasonably chargeable monthly as they occur; the professional fee, which represents the continuous personal service of the architect, is likewise reasonably chargeable in monthly installments as the service rendered. If a large proportion of the service is rendered at the beginning of the undertaking, these monthly payments, aggregating 80 per cent. of the fee, may be completed when the building is perhaps half done, no further payments on the fee being made until the final 20 per cent. is paid on issuance of final certificate. If, however, the personal service continues fairly steadily throughout the work, then a larger number of smaller payments would be arranged. For instance, suppose a $50,000 residence:—a professional fee of $2,000. Duration of the work from date of agreement to final certificate estimated at eighteen months. Retained for payment on issuance of final certificate, $400. Balance, $1,600, paid in sixteen monthly payments of $100, or perhaps ten monthly payments of $160, as conditions might warrant.

Rendering monthly charges against the fee in this way is advantages to the architect, in that it gives him a steadier income. It is acceptable to the owner, since it creates a definite monthly item of expense that is expected in connection with the other monthly expenses.

SUMMARY.

To summarize the arguments in favor of the Fee-Plus-Cost System, it might be said:

(1) The architect's professional compensation is made independent of the cost of the work.

(2) The architect's profit is based directly on the intensity and duration of his personal service and the responsibility involved.

(3) It is guaranteed and can therefore reasonably be reduced to a minimum that is proper in each case.

(4) All costs involved in a building project are paid for by the owner of that particular piece of work and are not in some cases compensated for by excessive payments by other owners.

(5) Excessive draughting required by an owner is paid for by the owner and does not operate to reduce the architect's profit. Also an architect is not tempted to curtail desirable draughting in order to increase his profit.

(6) While all costs are charged to the owner under this system there are only two elements of cost that are not charged in the same way under the percentage system, i. e., draughting and overhead costs.

Heating a Conservatory and Greenhouse

By J. D. HOFFMAN

(Read before the American Society of Heating and Ventilating Engineers, Detroit, Mich., July 21, 1916.

IN the spring of 1911 the author was asked to lay out the heating system for a conservatory and greenhouse building, then in the process of erection. As the conditions that had to be met were somewhat unusual and since it has now had five seasons of successful service, a description of the heating system may be of interest to the members of the society.

Fig. 1 shows the location of the new conservatory relative to the old one, which had been fitted up in 1909, and from which building all the plant development in the new building was to be directed. Because of the close connection between the work carried on in the two buildings and to simplify operating conditions, the new heating plant was connected with the heating plant of the old conservatory. The latter was housed in a one and one-half story wing on the south side of a three-story building devoted to agricultural experiment work. The heating system in this plant was hot water, open tank type, with the radiators and coils all connected on the downward-flow principle, i. e., all the hot water from the heater was directed first to the highest point of the circulating system and then subdivided to the various coils and radiators on the return flow. The old conservatory rooms were badly cut up and the heating connections were rather complicated, but this system was then giving satisfaction, and no changes were contemplated in that part.

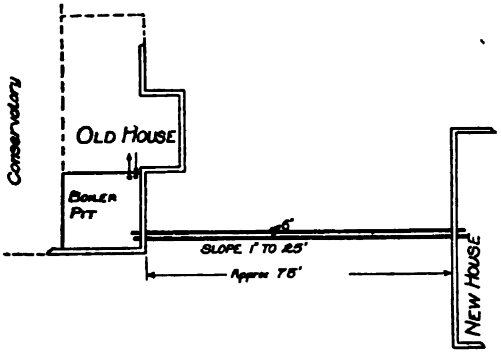


FIG. 1—CONDUIT CONNECTIONS TO NEW CONSERVATORY.

The problem was to connect the new heating system of 5,000 sq. ft., by conduit to the old heating system having 1,200 sq. ft. of radiation, increase the heater plant from 1,850 to 8,000 sq. ft. rated capacity, reconstruct the system of mains at the heaters and serve both systems from the same plant without intering with the operation of the old plant.

The new conservatory consisted of a two-story brick front building with two 25x100 ft. greenhouse extensions. The second floor radiation in the conservatory was to be planned but not installed with the heating system; consequently the new system would operate for the present on the expansion tank in the old system. At a later date, if the second floor heating were installed, this tank would necessarily be raised to a higher position or moved to the new plant since the new elevation would be above that of the present tank.

The feature that caused the greatest concern in the union of the two systems was the fact that the circulating water had to be carried by conduit a distance of 100 ft. with a rise of less than 6 in. and then extended beyond this point a distance of 100 ft. through mains and coils, as shown in Fig. 2, with a rise of not to exceed 3 ft. The heaters had to set in the present pit. This was sufficiently low to give a fair depth of conduit, but permitted very little pitch to the mains. The heating plant was installed according to the plans without change. When completed every coil and radiator in each of the two systems did its work satisfactorily from the first firing and has

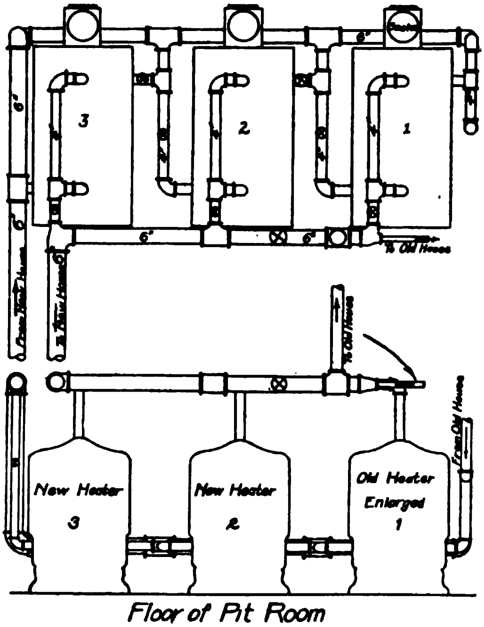


FIG. 3—REVISED HEATING PLANT IN OLD CONSERVATORY.

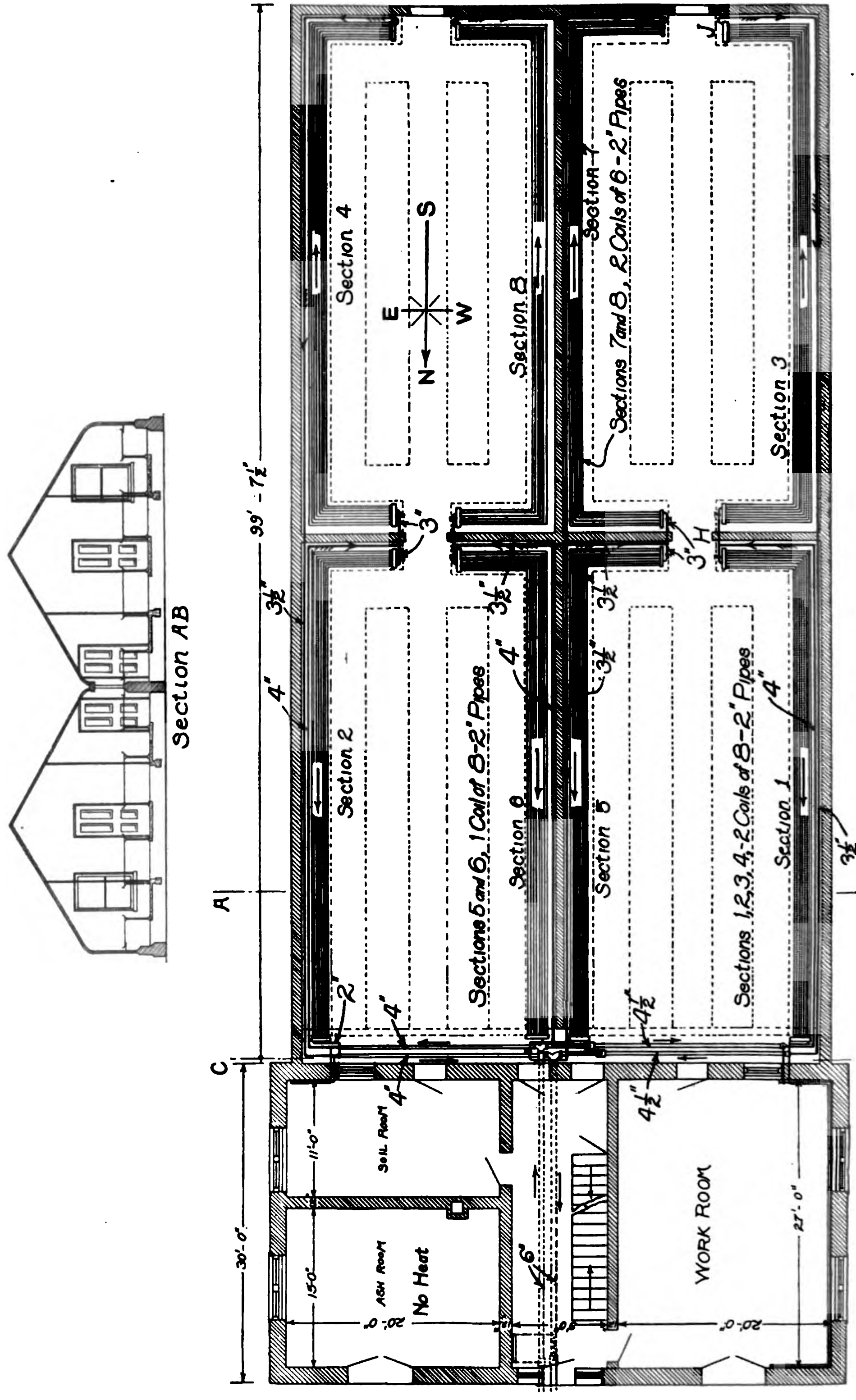


FIG. 2—GROUND FLOOR PLAN OF NEW CONSERVATORY.

been equal to the most extreme weather conditions experienced.

The calculations for the various rooms for an inside temperature of 70° F., an outside temperature of —10° F. and an average water temperature at the coils of 165° gave:

Two type W-25-8 Ideal boilers of 3,050 sq. ft. capacity each, were installed for the new plant. This was 20% above requirements and served as a safety factor. Provision was also made to enlarge the old boiler by three sections and make the three heating units equal. The two

	Heat loss B.T.U.	Radiation Approx., sq. ft.	Coils
Work room	23800	140	280 lin. ft. 1½ in. pipe
Soil room	8500	50	100 lin. ft. 1½ in. pipe
Hall	12750	75	150 lin. ft. 1½ in. pipe
North greenhouse (each)	149600	880	5000 lin. ft. 2 in. pipe 375 lin. ft. 3½ in. pipe 175 lin. ft. 4 in. pipe
South greenhouse (each)	168300	990	
Store room (later)	66300	390	
Basement (later)		150	
Total		4545	
Mains and branches		500	
		5045	

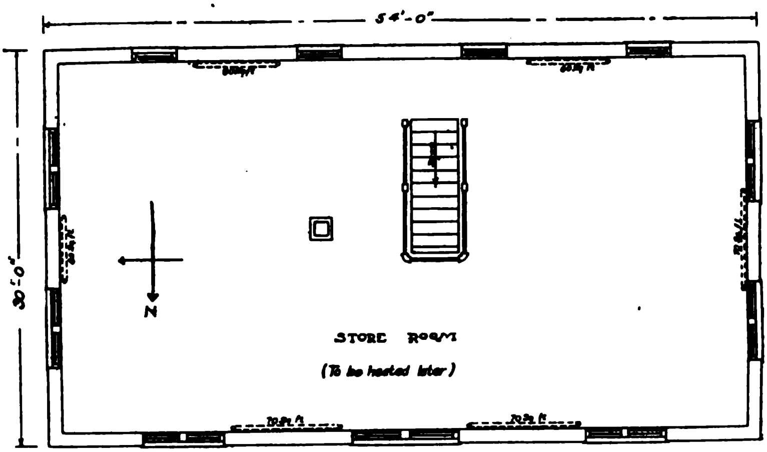


FIG. 4—PLAN OF CONSERVATORY BASEMENT.

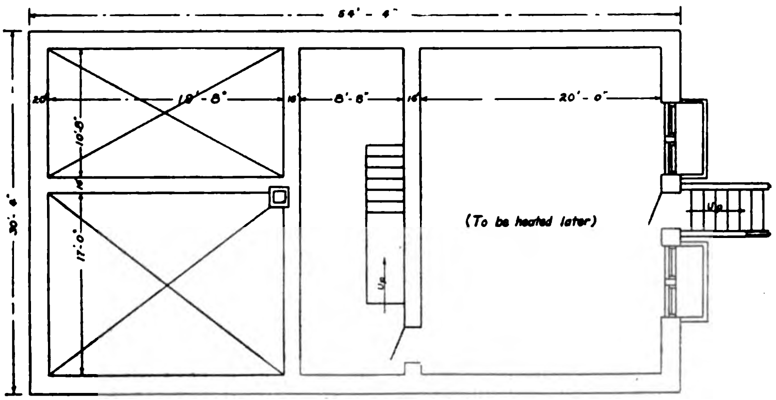
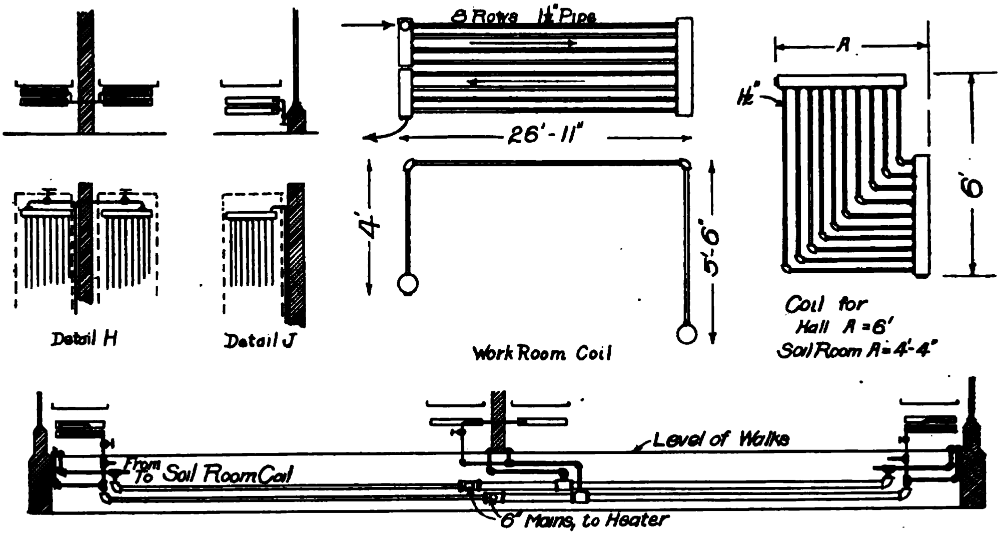


FIG. 5—PLAN OF SECOND FLOOR OF CON SERVATORY.



Section C-D Showing Elevation of Piping

FIG. 6.—DETAILS OF COILS AND CONNECTIONS IN GREENHOUSE.

new units were connected to the old one, as shown in Fig. 3, in such a way that any heater could be used on either or both systems, as desired. The 66-gal. expansion tank was replaced by a 100-gal. tank. The system of mains was arranged to have a uniform rise from the heaters to the ends of the cross trench at the entrance of the greenhouses. From these two branch mains, risers and leads were taken off to the various coils.

The highest point in the greenhouse system is on the line H, Fig. 2, at the center of the greenhouses. The coils are fed along this line and the flow through the coils is toward the ends of the greenhouses. The coils farthest from the conservatory building, being at a disadvantage, were given a slight advantage in heating surface. All coils were built up with manifold ends and each section was valved with a straightaway valve, so that it could be cut out for repairs. Radiation was planned for in the second floor and the basement, Figs. 4 and 5, but was not put in at that time. Fig. 6 shows the details of the coils and connections to the mains.

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The ninth annual meeting of the American Institute of Chemical Engineers will be held in New York City, January 10-13, 1917.

Government Experiments on the Transmission of Heat Through Walls.

It is well-known that the Bureau of Standards, at Washington, has been delving into the matter of the transmission of heat through walls, etc. This work has been undertaken with special reference to its bearing on the refrigeration and cold storage industry, but the same principles apply to a wall which is intended to keep in heat as to one intended to keep out heat.

In an address before the master steam fitters' convention, in Atlantic City recently, Dr. Hobart C. Dickinson, physicist of the bureau, gave some interesting details of the bureau's researches in this connection. As he stated, the problem, of course, is an old one, and all are familiar with tables of heat transmission through building materials. All are equally familiar with the very great discrepancies which exist in such figures, and the more carefully one goes into the available literature and tables the more he is convinced of the unreliability of the results which are available. The discrepancies, said Prof. Dickinson, are due partly to the complexity of the problem, and partly to the unreliability of many lists which have been made.

In considering the heat transmission through a wall, continued Dr. Dickinson, neglecting the matter of leakage of air which evidently depends upon tightness of construction, kind of ventilation, etc., the resistance which a wall offers to the passage of heat may be divided into several parts; first and simplest is that of the solid material of the wall itself. Provided there are no large air spaces introduced in the material, heat is transmittable at a rate proportional to the different of temperature between the two surfaces of the solid material. Inversely proportional to the thickness, the rates for different materials are proportional to their thermal conductivities. The transmission is also almost independent of the actual temperature; for instance, between 0° and 10°, or between 80° and 90° F., inside and outside temperature the heat transmittable will be very nearly the same.

If we had reliable figures for the conductivity of all building materials, which the Bureau of Standards is now engaged in securing for experiment, this part of the problem of heat lost through walls would be completely solved.

CONDUCTIVITY OF BUILDING MATERIALS A SMALL PART OF PROBLEM.

Unfortunately this is a very small part of the problem. The occupants of a house, and hence the heating engineers, are not much interested in the temperature of the surface of the wall, but rather that of the air in the rooms. Nor do we often measure the temperature of the outside surface of the walls of a house, but rather the temperature of the air outside.

In order to escape heat must get from the air of the room to the surface of the wall, and from the outer surface of the wall to the outside air, and the resistance offered by the air next the wall on both sides is often a very good part of the whole. If the air is not disturbed by forced draft, the air films of the two sides of the wall may offer as much resistance to the passage of heat as an inch of pine. On the other hand, if the air is in rapid motion, or when a wind is blowing on the outside of a building, the resistance of the air layer may be practically nothing, and the wall surface may be at very nearly the temperature of the air at some distance from it, which is evident in the case of a window surface; the glass of an ordinary window by itself has very little resistance to the passage of heat, yet in practice the heat loss through window area is reasonably small, but it is probably nearly twice as great when a heavy wind is blowing as it is with no wind. The window loss would be from ten to twenty times as great were it not for the air films on the inside and outside.

Evidently a knowledge of the effect of air films is necessary before any complete tables of heat loss through walls can be accurately prepared. The effective resistance of the air film or layer depends upon numerous factors. It is not proportional to the temperature difference. It is not independent of the absolute temperature, as is the resistance of solid materials. Moreover, it depends upon rate of air circulation and height of the unbroken wall surface. This being the case, it is hardly to be wondered at that no adequate study of the problem has ever been made. In fact, as the rate of air circulation on the outside of buildings due to wind is beyond our control, so even if we knew the heat loss for all wind velocities, this knowledge would be of little value without a knowledge of the wind velocities.

THE BUREAU OF STANDARD'S EXPERIMENTAL APPARATUS.

The bureau is preparing—in fact, has most of the apparatus ready—for measuring the rate of heat transfer from air to wall under all kinds of conditions. Such measurements as this have never been satisfactorily made, and it is hoped that the results obtained will be valuable.

A somewhat simpler phase of this problem has been under investigation at the bureau for two years or more. In various kinds of construction, between double windows in frame houses and in various other places closed, so-called dead air spaces are made use of for preventing heat loss. A knowledge of the effect of such spaces has proved of great importance in connection with the insulation of steel cars, refrigerator cars, household refrigerators, and the cold storage houses also, where air space construction is sometimes employed.

The bureau has made thousands of observations of the heat transmission from one wall to another, across air spaces from 1/32 in. to 3 in., for numerous heights, between 1 in. and 2 ft., and for a wide range of temperature difference, and these data are not yet completely assembled.

◆

A University Directory with 32,000 Addresses.

Former students, alumni, faculty members, administrative officers and trustees of the University of Illinois are listed in a new directory published by the university at Urbana-Champaign, Ill. It contains over 32,000 names and addresses arranged alphabetically, as well as geographically by States and towns and foreign countries. The occupations are also included. The directory sells for $5.00.

THE HEATING AND VENTILATING MAGAZINE

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PUBLICITY for the work of the heating and ventilating engineers was given with a vengeance by the Detroit papers on the occasion of the engineers' recent meeting in that city. Such headlines as "Old Formulae Are Thrown in Discard" and "Heating Rules Change" are merely samples of the weird things expressed by the Detroit press. These startling headlines were inspired by some recent tests at the University of Michigan on heat losses through building materials which indicated that the usual coefficient of 1, ordinarily used in connection with glass surfaces, should be raised to 1.48.

The technical paper, however, that offered the best opportunity for the reporters' flights of fancy was one on the best position for a radiator in a room, which is reproduced in this issue. After noting that a position in the center of the room was favored as the point where the radiator would show its greatest efficiency, the reporters' pencils fairly ran riot over the engineering "errors" of the past in locating radiators under windows, while the necessary touch of humor was injected into the reports by the movements of the late homecomer who would crack his shins against the radiator as he groped across the room.

In short, the Detroit papers had plenty of "atmosphere" to their reports of the convention but succeeded as far as was possible in holding up the profession to ridicule. It is safe to say that the average Detroiter, in reading the newspaper reports of the meeting gained an altogether wrong impression of the character of the heating engineers' profession.

The reports as published were neither good newspaper work nor in accordance with good newspaper ethics. Heating engineers owe it to themselves to prevent, as far as possible, this kind of publicity and while it is impossible to censor the writings of the reporters, it is quite possible to prepare, in advance of or during engineering meetings, suitable reports that may be given out for publication and which will present the activities of the profession in their proper light. The local chapters or other organizations, for their part, can do much in this direction by promptly calling the editors' attention to the incorrect presentation of reports or to engineering misstatements in general.

◆

FOLLOWING the plan of publishing occasional special numbers, the October issue of THE HEATING AND VENTILATING MAGAZINE will be a smokeless boiler number. Articles representing the viewpoints of the manufacturer, engineer and contractor on the smokeless boiler situation will be included, as well as a discussion of smoke ordinances for large and small cities and other matters dealing with the rapidly-growing use of smokeless boilers, with a view of securing smoke abatement as well as greater fuel economy.

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

64—Heating Costs for Dwellings.

Qhestion: Can you tell us what is good heating practice per cubic foot for an ordinary brick dwelling, exposed on all sides, in a climate such as we have in Dayton or Cincinnati, Ohio? The type of heating apparatus used is the ordinary warm-air furnace. I am trying to arrive at the cost to a householder of heating his residence, under average conditions, with Pocahontas coal.

Answer: As far as figures are concerned, it would be almost impossible to arrive at anything but a guess. A warm-air furnace presumes the use of outdoor air for ventilation, as well as for heating. In case air from the cellar is used and recirculated the fuel bill will be reduced considerably. Another very variable factor entering into the problem concerns the size and type of furnace in any given case. Most warm-air furnaces in private houses, especially those known as speculative houses, are about two sizes too small and in extreme weather the householder heats about one-half of the house, closing up the remainder until the weather moderates. Others do not heat their houses adequately, due to the expense of fuel.

In all of the cases above cited the total fuel bill will be considerably lower than if all outside air were used and all rooms adequately heated to 70° F. at all times. It has occurred many times that a steam or hot water system has been substituted for a warm air furnace and the owner has been dissatisfied because there was no decrease in the coal bill and sometimes an increase over previous conditions. In such cases the increase in capacity of the direct steam or water system over that of the warm-air furnace, and the fact that all rooms were kept at 70° in all weather, were taken into consideration.

Another important point involves the use of storm windows or outside sash in winter, as they effect a saving in fuel of from 30 per cent. up.

If our correspondent will collect the data as indicated the writer will be pleased to analyze it for him. The data should include pounds of coal per week or known period, cubic feet of gas used per period and cubic contents of the house heated, also type of range used and whether double windows are use. If possible the area of the cold air box leading to the warm-air furnace should be added.

◆

Relative Capacity of Steam and Hot Water to Carry Heat.

In Answer 63 of "The Consulting Engineer," published in last month's issue, on "What Is the Best Type of Heating System?" a comparison was made between the capacity of steam and hot water to carry heat. . In this discussion it should have been stated that steam has a physical quality of giving up 1,000 B. T. U. approximately of latent heat when condensed to water, although it is 1,700 times the volume of water at atmosphere. It has a volume of 25 cu. ft. to the pound, so as, compared with water, with 25° drop, the quantity of steam required for the transmission of 1 B. T. U. or any given quantity of heat, would be as follows:

$$[1000 \text{ (lat. ht.)} \div 25 \text{ (cu. ft. per lb.)}] \div 62 \text{ (wt. 1 cu. ft. water)} \times 25 \text{ (press. drop)} = 40 \div 1550 = 2.6\%, \text{ or}$$

a cubic foot of steam conveys 2.6% the heat of a cubic foot of water under the conditions named.

◆

Furnace Trade Stirred by University Booklet on House Heating.

An innocent-looking booklet on "House Heating," by J. L. Mowry, Division of Agriculturing Engineering at the University of Minnesota, has stirred up a hornet's nest among many sheet-metal and warm-air furnace men, one journal asking, in display lines, "Will You, Mr. Furnaceman, Stand for This?" The National Association of Sheet Metal Contractors, at its recent convention in Peoria, Ill., also took occasion to pass a resolution condemning the booklet in no uncertain terms.

The cause of all this outcry are the following statements made by Mr. Mowry in connection with a description of the principles of warm-air furnace heating:

"The principle of this scheme for heating is good, but there are many weak points and objectionable features in practice. (1) It is hard to clean and to fire. (2) When made of sufficient capacity for the average-size house, the fire-box must be made in sections which do not fit tightly together, and the result is dirt, smoke and gas in the rooms. (3) The most serious objection is the influence of wind upon the circulation of distant rooms. It is impossible to carry heat against the wind more than 8 ft. or 10 ft. from the furnace.

"These facts, and the burning of the air in order to get heat sufficient to warm the rooms, limit the usefulness of this style of heating to small houses, and generally to one floor. To be successful, the furnace must be large and the pipes from 50 to 100% larger than are ordinarily used.

"First, floor pipes may be made any size and should be from 12 to 16 in. in diameter. Second floor rooms must be reached through rectangular ducts, about 4 in. x 14 in. in size, between studding. These are really much smaller than round pipes 8 in. in diameter. Unless special construction allows a large pipe to the second floor, it will be found difficult to heat upper rooms, especially to windward."

The statement, however, which aroused the most excitement was that "a hot-air furnace will last seven or eight years if repaired every two or three years. The hot water plant should wear 20 years and many have been used longer with little or no repairs."

In justice to Mr. Mowry it should be stated that when he came to a discussion of hot water heating he was no less free in his criticisms of this method, for he says: "Objections to this system (hot water) are: The need of safety devices, which may fail, and harder firing, which requires more fuel."

At the end of the booklet, in discussing costs, he says: The cost of a hot water system for a six-room house will be about $275 or $300. It will cost about two-thirds more than hot air, but hot-air outfits last only 7 to 9 years, with yearly repairs, while the hot-water system will last from thrice to six times as long, with no expense for upkeep.

"The cost of a hot-water system will be about $85 or $90 for radiators, $130 for the heater, and about $65 for installation. Any farmer who is at all handy as a mechanic can do the work, leaving $210 for the plant, compared with $175 for hot air

"A hot-air system may give reasonably satisfactory results in small buildings, but for large houses and under most conditions, either steam or hot water is unhesitatingly recommended. The higher cost is more than offset, in a few years, by a saving in fuel and more satisfactory results."

STEAM HEATING ALSO CONDEMNED.

The bulletin concludes with the following crack at steam heating:

"Nothing has been said about steam systems. Little need be said. They are like water systems in makeup, except that the expansion tank is closed. There is no water in the radiators, only in the heater. There is no circulation until the water in the boiler is boiling, and there is pressure in the pipes and radiators. This pressure, while not intended to be heavy, may become so if not watched carefully. This is impossible in the average home. In the mill, factory or large flat building, there is reason for keeping a man on duty constantly, but not so in the home.

"By the process of elimination, it can safely be claimed that steam is not safe and hot water is not satisfactory, to any degree; while hot water, not perfect because it costs too much, is the best system of the three for heating the home."

Professor Mowry in responding to some of the criticisms leveled at him, writes: "I, of course, have been within range of numerous protests and criticisms upon the stand I have taken with respect to hot-air heating. The exceptions have been taken by men and firms exclusively in a section which is many miles south of Minnesota. They have overlooked the fact that the bulletin was made for Minnesota conditions, that the statements are drawn from observations as we find the installations in this section."

Current Heating and Ventilating Literature.

(Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.)*

COMBINED PLANT.

Problem in Combined Power and Heating (70771). Charles L. Hubbard. Ills. 3500 w. N E—June, 1916. Method of estimating approximate results under given conditions. 20c.

FACTORY HEATING.

How to Increase Factory Efficiency (70603 A). O. M. Becker. Ills. 3500 w. E M—June, 1916. Third of series of articles; how to heat the factory. 20c.

THERMODYNAMICS.

Flow of Heat from Solids to Air (70824 N). E. E. Snyder, C. S. Robinson, and W. K. Lewis. 1000 w. J I & E C—June, 1916. Investigation. 20c.

LEGAL DECISIONS

Discontinuance of Heating Service on Operation at Loss.

A steam heating company, which had supplied the city of Pana, Illinois, with heat for several years, notified the consumers that it could not furnish them with any more heat. The Illinois Public Utilities Commission, on complaint by the city, held that the utility could not discontinue service merely because it operated at a loss. The Commission has power to permit a utility to discontinue service where the conditions justify and demand it, and if the company could not serve the public without loss at the rates charged it should apply to the Commission for an increase of rates, or, after reasonable notice of its intention given to the public, for permission to discontinue service. (Pana vs. Central Illinois Public Service Co.)

The company subsequently applied to the Commission for permission to discontinue its heating system in the city. It alleged that during the last heating season the gross earnings were $1,867.84, and operating expenses during the same time were $4,102.49; that to attempt to increase the rate for the service sufficient to defray the reasonable charges therefor would result in a cost which consumers could not reasonably afford to pay; and that notice had been given to patrons. The application was granted. (Ex parte Central Illinois Public Service Co.)

Building Ventilation Regulations.

The Missouri Supreme Court holds that under Article XI, Section 1, of the State Constitution, for establishing a public school system by the General Assembly, and the Act of 1897, amended in 1909, providing that cities of 500,000 inhabitants shall constitute a school district and have certain corporate powers, including the care of school buildings, their ventilation, etc., a regulation of the St. Louis Board of Public Improvements as to building ventilation does not apply to the construction of school buildings, notwithstanding the city charter.—Board of Education vs. City of St. Louis (Mo.), 184 S. W., 975.

CORRESPONDENCE

Capacity of Heated Air to Carry Moisture.

EDITOR HEATING AND VENTILATING MAGAZINE:

In an answer to one of your correspondents, published in the August issue, on the subject of the capacity of heated air to carry more than 50% of saturation, the statement is made that in a drying installation in Cuba, the air was applied at such a high temperature that they had complete saturation when the outside temperature was 90° F., the air escaping from the dryer having every appearance of steam. How do you reconcile this statement with that quoted from "Kent," where it states that "as a carrier of moisture hot air cannot in practice be charged beyond half its full saturation; and it is, in fact, considered a satisfactory result if even this proportion is attained"?

It is probable that the statement in "Kent" means to imply that the latent heat taken up in the evaporating process so reduces the temperature of the air when it leaves the dryer that when it is completely saturated at the leaving temperature, the volume of moisture absorbed scarcely represents 50% of the absorbing capacity of the initial temperature of the air as it goes into the dryer. Such a statement would be correct, but in its present form the statement is not borne out in practice.

A cubic foot of air at 50° F. and 50% saturated will contain 2.12 grams of moisture. It would have a wet bulb temperature of about 42°, and a dew point of about 30.05°. Now, if we were to raise the temperature of this cubic foot of air to 200°, it would have a wet bulb temperature of about 88°, and would have a capacity to absorb 207 grains of moisture when completely saturated. The original cubic foot of air heated to 200° would only be 1.025% saturated, if no other moisture is added. This original cubic foot of air at 50°, however, would expand about 29% by heating it. Therefore, the cubic foot of air at that temperature would not have the same carrying capacity as the expanded cubic foot of air would have.

In many instances, when applying blower systems to the drying of products containing considerable moisture, the product being of a character that would permit of heating it to temperatures above the boiling point, moisture has been evaporated at such a rate that the water passed off as steam, practically coinciding with the volume in cubic feet of steam at 1 lb. pressure as given in the tables of properties of saturated steam.

For example: In Cuba a very large dryer was installed for drying sugar cane before the sugar is extracted from it. The cane averages 76% moisture and that is reduced down to 9% in less than 40 minutes at the rate of 150 tons per 24 hours, and with a volume of air that would indicate that the plant was handling about 26 cu. ft. of air per lb. of moisture, which is very close to the amount of steam in a cubic foot at atmospheric pressure.

If, however, provision is made so that heat is applied in the drying process sufficient to establish an equilibrium with the amount of latent heat absorbed by evaporation, then the temperature of the outgoing air would be just as high as the incoming air temperature and in that event there is no reason why the air could not be completely saturated at its initial temperature or its outgoing temperature.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Board of Directors Indorses Proposal to Change Name of Association.

In the report of the Board of Directors of the National Association of Master Steam and Hot Water Fitters, presented at the recent convention in Atlantic City, a definite stand was taken in favor of changing the name of the association. Following are the board's comments on this subject, as presented in the associations "Official Bulletin."

"Your board believes that the present name of our Association, 'The National Association of Master Steam and Hot Water Fitters,' is not the most fitting name for our organization as at present constituted; it admits more or less of an ambiguity, and is more suggestive of an association of journeymen than it is of an association such as ours.

"To give you an idea of what we have in mind, how would the following do: 'The National Association of Heating and Ventilating Contractors'? We do not submit this as a name, but merely as an example of what is possible, but if the idea in itself meets with your approval, we have to recommend that you appoint a committee to consider the question in all its phases and report on same at our next annual convention.

"In making this suggestion, we are not unmindful of the fact that to make the change will entail more or less work, and some little expense, but inasmuch as we are building for the future as much as for the present, we should hand down to those who succeed us a name which is consistent with what we really are."

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The Progress of Standardization in the Steam Fitting Trade.

Following the preparation of a standard schedule of flanges and flanged fittings which has been adopted under different names by the National Association of Master Steam and Hot Water Fitters and by the American Society of Mechanical Engineers, as well as by other bodies, an effort has been made during the past year by the master fitters' association to develop a schedule of standard radiator valves. Early in the year the committee at work on this proposition made a tentative schedule of dimensions for radiator valves. This was presented to the Valve and Fittings Manufacturers' Association with a request that they consider it, the committee having learned from experience that in order to standardize any particular line of manufacture, the first and most important move is to get as many as possible of the manufacturers of that particular line to co-operate with it. The further course of events is told in the report of the standardization committee of the master fitters' association:

"We tried to make it quite clear that the schedule submitted was merely tentative and subject to changes if they found changes were necessary; that we were not after any particular set of dimensions, or any particular make of valve, but our whole purpose was standardization and interchangeability.

"The Manufacturers' Association acknowledged our request and appointed a special committee, of which Mr. John O'Brien, of the Fairbanks Company, was made chairman to consider the schedule.

"During the next two or three months we heard that Mr. O'Brien was organizing his committee and expected that they would soon meet us in joint conference.

"We waited patiently for some time expecting to hear from Mr. O'Brien and finally requested our secretary to get in touch with him and urge him to action, when we found that Mr. O'Brien had severed his connection with the Fairbanks Company, and had turned all the papers pertaining to standardization over to the Fairbanks Company, which in turn had laid them away and given no thought to them.

"We at once took the matter up with Mr. Houser of the Crane Company, who is chairman of the general standardization committee of the Manufacturers' Assocta-tion, and he was apparently surprised at the way matters had been dropped and promised to see that a new chairman of the special committee was appointed at an early date.

"On April 6 we received a letter from Mr. Houser requesting a conference with the chairman of your committee. This conference was held in our association headquarters in New York on April 14, and was attended by Mr. Houser, of the Crane Company, and Mr. Gordon, of Jenkins Bros., representing the manufacturers, and Mr. Child and the chairman of your Committee on Standardization, representing our association (W. T. English).

"At this conference there was considerable discussion as to how far the standardization of parts was to be carried, and some of the difficulties and expense of attempting to carry it too far.

"Considering the fact that our principal reason for standardization of radiator valves is for roughing in on new work and for making repairs on old work (the larger part of which will be either an entire new valve or a new hand wheel) it seemed to be consensus of opinion that if we standardize the center to face of the inlet and outlet of radiator valves with and without unions and the method of attaching the hand wheel, we will have all that is necessary. Repairs on other parts of a radiator valve occur so seldom that it seems unreasonable to ask manufacturers to go to the expense necessary to standardize the entire valve, as in many instances it would require an entirely new set of patterns and tools.

"Standardization is not going to keep the cheap and lighter grade of valves out of the market. We all have jobs where we are forced to use them.

"Taking this into consideration, isn't it better to standardize only the principal dimensions as suggtsted above, which will give us a chance to bring both the high grade and cheaper valves to the standard, because these changes can be made at small cost to the manufacturer, than to attempt to standardize all the parts which must necessarily make a high priced valve?

"We are of the opinion that if we are content to standardize only the parts referred to above, viz., center to face each way and method of attaching wheel, that an agreement can be accomplished with the manufacturers to do this, but if we insist on a complete standardization of all parts as shown in our tentative schedule, it would entail a big expense to the manufacturers, and we doubt very much if any or many of them would consider it.

"The conference was most harmonious, and Mr. Houser assured us that a new chairman of the special committee would be appointed at the next meeting of their general committtet.

'We feel reasonably sure that tnis matter is now well in hand and we hope at our next convention we may be able to report an agreement with the manufacturers' association for some kind of a standardization of radiator valves."

Items to Be Considered in Figuring Overhead Expense.

In discussing the cost of doing business, at the recent convention of the National Association of Master Steam and Hot Water Fitters, one of the members presented the following list of items in the heating and plumbing business that should be considered in figuring overhead expense:

SALARIES.

Employers' salaries, less productive portion of same.
Executive officers' salaries (if incorporated).
Bookkeeper's salary.
Stenographer's salary.
Clerk's salary.
Other office help.
Stockkeeper's salary.
Driver's salary.
Chauffeur's salary.
Other non-productive labor.
Office collector.

RENT OR ESTABLISHMENT MAINTENANCE.

Store rent.
Shop rent.
Gas and electric bills.
Heating.
Depreciation on office equipment.
Depreciation on shop equipment.
Depreciation and repairs to tools.
City taxes.
County taxes.
Depreciation on real estate.
Maintenance of real estate.
Cleaning show room and establishment.
Fire Insurance.

DELIVERIES.

Barn rent.
Horse and wagon maintenance.
Depreciation on same.
Garage rent.
Automobile maintenance.
Auto truck maintenance.
Gasoline and oils.
Depreciation.
Liability insurance.

ASSESSMENTS, DUES AND DONATIONS.

Association dues.
Other organization dues.
Business life insurance.
Builders' exchange dues.
Chamber of commerce dues.
Donations.
Tickets.

SUNDRY BUSINESS EXPENSES.

Plumber's bond.
Compensation insurance.
Liability insurance on work.
Fire insurance on stock.
Government taxes.
State taxes.
Corporation taxes.
City taxes.
County taxes.
Telegrams.
Stationery and printing.
Postage and revenue stamps.
Expense—car fares.
Expense—cartages.
Collection charges (attorney's bills).
Commercial record or other credit information.
Office supplies.
Advertising.
Text books.
Buying directory.
Trade magazines.
City directories.
Signs.
Wrapping paper, packing boxes and barrels.
Attending convention expenses.
"First aid medical kit."
Typewriter and adding machine repairs.
Interest on notes payable.
Interest on investment.
Depreciation on stock and fixtures.
Lost accounts.
Lost shop time.
Depreciation on equipment.
Deadhead repairs or "come backs."
Incidentals, and all other items you pay for which you do not sell, except equipment.

This formidable list was characterized by President Bradley, of the association, as "some expense," but he added that it would bear investigation, as he wondered how many contractors were in the habit of figuring all of these items of expense in a year.

The discussion of the general subject of overhead expense brought out the fact that from data obtained the range of this item was quite remarkable, running anywhere from 8% to as high as 30%, although many figured their cost of doing business as between 22% and 26%.

In the case of a certain master plumbers' local association where most of the plumbers do steam fitting, an effort was made to get all the firms in the local association to report on the matter of overhead expense. Eleven firms responded on a total of $758,000 worth of business, half plumbing and half heating. The overhead expense averaged 22%, amounting to 26% on their cost.

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Present Attitude of the Government Towards Trade Associations.

That a more helpful attitude towards trade associations is being taken by the government received fresh proof in an address by Edward N. Hurley, vice-chairman of the Federal Trade Commission of the United States, presented at the recent Atlantic City convention of the National Association of Master Steam and Hot Water Fitters.

After giving an account of the activities of the Federal Trade Commission, he went on to say:

The activities of trade associations, like yours, and similar business organizations, are manifold, and the business done by their members runs into the billions. These groups of associated business men are putting forth special efforts to improve systems of cost accounting, bettering their processes of manufacture, standardizing their output, obtaining credit information, and endeavoring to advance the welfare of their employes, and are bound to be most important factors in our country's development in the course of the next few years.

Special commendation should be given to associations that are endeavoring to build up industry in these constructive ways. Successful production and successful merhandising require many steps in the process of changing the form of the raw materials, and putting the product on the market at a figure adequate to cover the cost of production and the cost of selling and net some profit to the producer without charging the consumer an excessive price; and neither the individual business man nor the government alone can work out the many serious economic and business problems involved so successfully as a group of associated producers or merchants, laboring together in co-operation. These associations, when conducted intelligently and rationally, with the thought of bringing about improved business conditions, will make it possible for our industries to compete in price and quality in the markets of the world.

BETTERING CONDITIONS OF LABOR.

The question of giving to our workmen continuous employment so that longer periods of prosperity can be solved, and other plans for their welfare can be worked out, through trade associations. As we have grown in business capacity, we have come to realize that our employes are one of the most important parts of a successful establishment. That management is successful which is not only efficient in working out economies in production, but which also has the real interest of its employes at heart and which is anxious to have as many of its employes stockholders as possible, and which also realizes that without the hearty co-operation and enthusiasm of their men the best results cannot be obtained. Many corporations and firms ar now raising salaries and wages without the request from their employes. These benefits are commendable and should be supplemented by movements for the general welfare, planned and put into effect by our trade associations.

TRADE ASSOCIATION AND GOVERNMENT.

Business and government can co-operate through trade associations better than in any other way. The Federal Trade Commission's report on industries will furnish associations with facts and figures, not now available, which will enable them to assist in developing and stabilizing their industries. We talk much nowadays about industrial preparedness and the mobilizing of our industries in case of war. This can be accomplished through trade associations more quickly than in any other way. In the countries of Europe these associations, in co-operation with the governments, have been important factors in improving industrial conditions and particularly in extending foreign trade.

There should be a greater degree of organization and of mutual helpfulness in all lines of trade and industry, so that American business may be welded into a commercial and industrial whole; the part of the Government being to co-operate with business men, on request, to bring about the results that will benefit business and hence promote our national welfare.

VIEWS OF PRESIDENT WILSON.

President Wilson's views on trade associations may be of particular interest to you. In a letter addressed to me under date of May 12, 1916, he says, in part:

"Your suggestion, that trade associations, associations of retail and wholesale merchants, commercial clubs, boards of trade, manufacturers' associations, credit associations, and other similar organizations, should be encouraged in every feasible way by the Government seems to me a very wise one. To furnish them with data and comprehensive information in order that they may more easily accomplish the result that they are organized for is a proper and useful Government function. These associations, when organized for the purpose of improving conditions in their particular industry, such as unifying cost accounting and bookkeeping methods, should meet with the approval of every man interested in the business progress of the country."

UNIFORMITY IN ACCOUNTING METHODS.

The subject of more uniformity in cost finding is at present receiving the careful attention of trade associations. A number of trade associations are in this way achieving marked success in strengthening their industries. It is being demonstrated that a knowledge of cost determined by a uniform practice can improve trade conditions to a marked degree. By a uniform practice I mean a common classification of costs, a uniform method of distributing overhead expense, and a uniform method of providing for depreciation with rates more or less standardized. Where this condition exists, production statistics which are comparable and which will inform and guide the whole industry are obtainable. Manufacturers can then talk the same language and will be in a position to profit by each other's experience, to conduct their business more efficiently, and to establish prices more intelligently.

BETTER UNDERSTANDING BETWEEN GOVERNMENT AND BUSINESS.

Government has complained about business. Business has complained of the attitude of the Government toward business. Whatever justification there may have been in the past for such complaints, today there is a better understanding between Government and business. Since better business methods usually begin with better methods of cost accounting, scientific cost keeping becomes in a very definite sense the basis of our propsperity. The Government, through the Federal Trade Commission, by recommending the subject of costs to the business men of the country at this time, and offering to aid in the actual development of proper cost systems, is endeavoring to do a constructive piece of work which is of the greatest importance to the country. The problems of credit and finance, of foreign trade and unfair methods of competition, and of labor and capital,—all will begin to solve themselves once the subject of costs receives on every hand the attention it rightfully deserves.

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Farnsworth Mfg. Co., Boston, has opened a branch office at 20 East Jackson Boulevard, Chicago, with C. O. Lindahl in charge.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Illinois Chapter.

The following nominations have been made for officers of the Illinois Chapter of The American Society of Heating and Ventilating Engineers: For president, Fred Powers and W. A. Pope; for vice-president, E. V. Hill and George J. Phillips; for secretary, A. E. Stacey and R. B. Hayward; for treasurer, August Kehm and J. P. Dugger; for board of governors, E. L. Hogan. J. P. Tuttle, G. W. Hubbard, W. A. Cameron, E. J. Claffey and C. W. Johnson.

Headquarters of Civil Engineers Now at Engineering Societies Building in New York.

Announcement is made that The American Society of Civil Engineers has voted to accept the offer of the United Engineering Society to become an equal partner with the three founder societies in ownership, occupancy and administration of the Engineering Societies Building, in New York, and all other activities which the societies may jointly undertake. The civil engineers until now have occupied their own building on 57th street, New York. Their action is the result of a letter ballot of their membership. The vote was 6 to 1 in favor of the proposition.

Three stories will be added to the top of the Engineering Societies Building for the use of the civil engineers. Eighteen societies, including the three original founder societies, now make the building their headquarters.

New York School of Heating and Ventilating Preparing for Fall Season.

Preparations are going forward for the fourth annual season of the New York School of Heating and Ventilating which commences Monday, October 9. All lectures will be given at Room 511, World Building. Two courses have been arranged of eighteen and twelve lectures, respectively, the first year course covering the principles of heating and ventilation, and the second year covering high pressure and power work. Both classes will be under the direction of Charles A. Fuller, consulting engineer, with Clark, MacMullen & Riley, New York. The fee for each course is $10, and a discount of 5% is allowed to those using the coupon printed on another page of this issue. George G. Schmidt, 132 Nassau street, New York, is secretary of the school.

Opening for Heating Engineer.

A civil service examination for heating engineer for the office of the New York State Architect, in Albany, N. Y., will be held September 30 in various cities throughout the State in connection with examinations for other positions. The salary is stated to be $1,500 and $2,500 a year. It is further stated that the position requires technical ability to design and supervise the installations of different forms of heating and ventilating systems. At least five years' experience in the detailing, design or installation of mechanical equipment of buildings, power stations, etc., will be required. Credit will be given for technical education to an extent not to exceed two years' practical experience. Application planks must be filed in the office of the commission by September 20.

Fan Foundations for Noiseless Operation.

Fig. 1 shows a method of framing for fans, overhung pulleys and motors. The base of the apparatus is bolted to this coping with ½-in. lag screws, the coping being 3 in. all around larger than the base of the apparatus, and constructed of 3 in. x 8 in. dressed and oiled yellow pine, having halved joints at the corners.

Four ¾-in. anchor bolts are countersunk as shown in Fig. 2. Contact of the anchor bolts with the apparatus is avoided by this method, thereby insuring against noise. Under each bolt head a ⅛-in. steel washer is placed, resting in turn upon a rubber washer 1 in. in thickness. Underneath the coping a further precaution against noise may be taken by installing two layers of

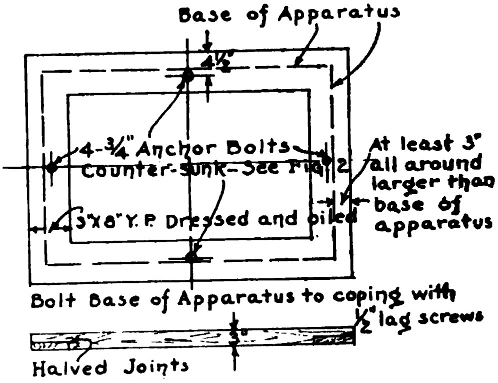

Base of Apparatus
4½"
4-¾" Anchor Bolts
Counter-sunk-See Fig. 2
At least 3" all around larger than base of apparatus
3"x8" Y. P. Dressed and oiled
Bolt Base of Apparatus to coping with ½" lag screws
3"
Halved Joints

FIG. 1.—METHOD OF FRAMING FOR FANS. OVERHUNG PULLEYS AND MOTORS TO PREVENT NOISE.

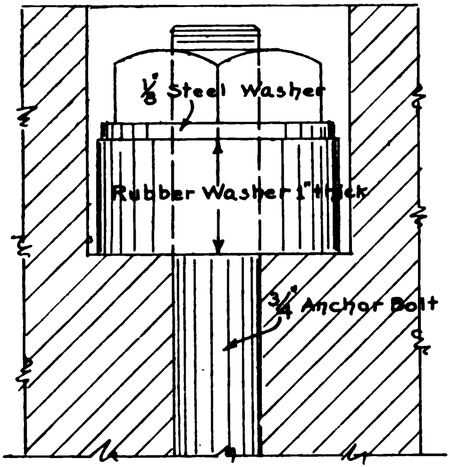


FIG. 2.—HOW ANCHOR BOLTS ARE COUNTERSUNK.

Nonpareil hard pressed cork, 2 in. in thickness. These rest directly upon the concrete foundation into which the anchor bolts are extended and imbedded together with 6 in. x 6 in. x ½ in. anchor plates. A complete installation is shown in Fig. 3.

Indirect Vento Stack Casings.

Vento stack casings arranged for gravity supply of air should be constructed of No. 22 gauge galvanized iron, using double lock standing seams. They should be substantially supported and put together with stack strips and bolts in such a manner as to be readily removable without breaking pipe connections and to permit access to the heaters. To protect the insulation the casings should be made of double construction which allows the insertion of ½ in. — 85% magnesia blocks. At the side or end of the stack casing two heavy 8-in. x 12-in. swinging clean-out doors should be provided with suitable catch plates placed in convenient positions. The most convenient arrangement of these doors is to have one near the bottom of the casing and the other near the top.

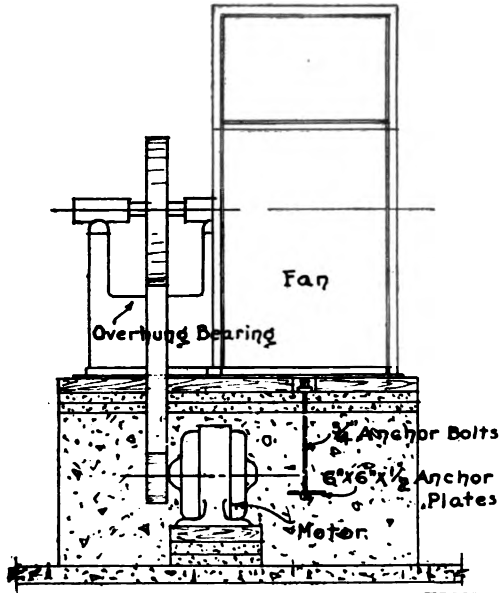
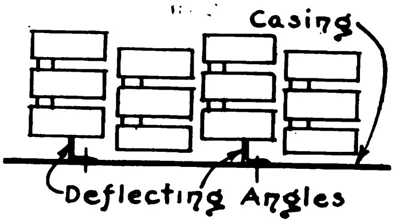


FIG. 3.—COMPLETE FAN FOUNDATION FOR NOISELESS OPERATION.

Staggering of Vento Stacks.

A simple method of staggering Vento stacks so as to obtain the maximum of heating effect is illustrated in the accompanying sketch. As shown, deflecting angles are secured to the Vento casing at every other row.



METHOD OF STAGGERING VENTO STACKS TO OBTAIN GREATEST HEATING EFFECT.

Detroit Section of Mechanical Engineers' Society.

A new section of the American Society of Mechanical Engineers is being formed in Detroit, Mich, the chairman of the temporary committee in charge being Ralph Collamore, the well-known heating and ventilating engineer of that city.

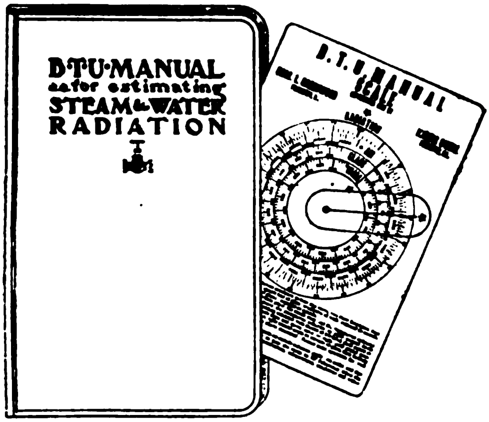
Plumbers' Indemnity Insurance Company Formed.

An insurance company has been formed in Buffalo, N. Y., with the object of assuming liability and compensation risks for Greater New York master plumbers exclusively. It is known as the Plumbers' Mutual Indemnity Insurance Company and was organized by E. G. Trimble & Co., of New York, Buffalo and Kansas City, Mo., which manages several other mutual and participating insurance companies.

The plan is to issue policies at the standard approved rates and, with the approval of the insurance department, return a 20% dividend in addition to maintaining the required loss reserves.

NEW BOOKS.

B. T. U. Manual for Estimating Steam and Water Radiation is the title of a new booklet, including a celluloid radiation scale for quick figuring. The tables, it is stated, have been carefully compiled from the foremost authorities and are based on the actual transmission of B. T. U. through various materials, and the B. T. U. emitted by radiation at various temperatures, pressures, etc. The tables show water radiation above and below zero at all temperatures, steam radiation above and below zero at all temperatures, at various pressures and for various elevations above sea level; radiation for brick walls of various thicknesses; complete pipe data; table for proportioning single-pipe steam mains; sizes of air ducts and registers for indirect heating; radiating surface supplied by hot water mains; risers for hot water and much miscellaneous information. The manual is leather-bound, with leather pocket for celluloid scale, and is indexed. Size 4¼x6¾ in. Published at $5 by Greenwood & O'Neill, Princeton, Ill., or may be obtained through the book department of The Heating and Ventilating Magazine.



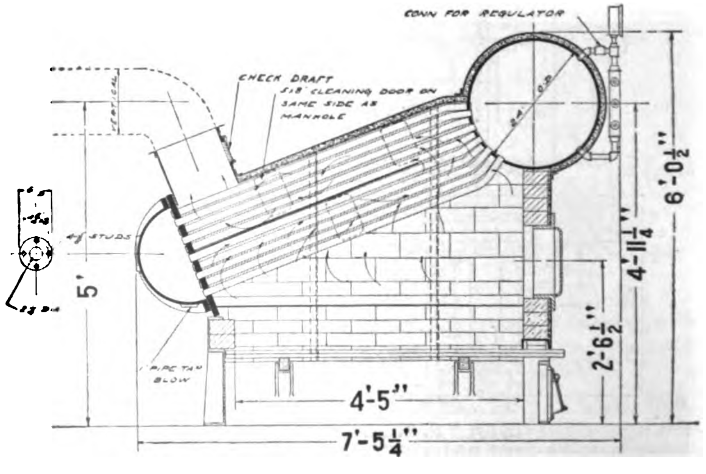
B.T.U. MANUAL FOR ESTIMATING STEAM AND WATER RADIATION.

Correction of Echoes and Reverberation in the Auditorium, University of Illinois, is the title of an interesting publication issued by the Engineering Experiment Station of the university and giving an account of the acoustic trouble that developed after the auditorium was built and the means that were taken to correct it. In seeking for the trouble, "bundles" of sound were projected in different directions and the paths of these were carefully traced. Various instruments, such as a ticking watch, a hissing arc lamp and megaphones were employed and curtains and draperies were hung at critical points suggested by the diagnosis. Certain of the walls were then covered with hairfelt, mounted on thin furring strips, with the result that at present a speaker with a moderate voice may be heard distinctly by auditors in the most distant seats of the large building. Dr. F. R. Watson of the Physics Department, and James M. White, supervising architect, had charge of the tests.

NEW DEVICES

The New Seabury Safety Heating Boiler.

The accompanying illustration shows the construction of the new Seabury safety heating boiler, of the low water-line type, which, as announced last month, has recently been placed on the market by Charles L. Seabury & Co., Morris Heights, N. Y. It is made in three sizes, having respective capacities of 2,500, 4,500 and 6,000 sq. ft. of radiation. The boilers are designed to carry a working pressure up to 50 lbs.



CONSTRUCTION OF SEABURY SAFETY HEATING BOILER.

As will be seen from the illustration, the steam drum rests on cast-iron columns and the water drum on a cast-iron bridge on which it is free to slide according to contraction or expansion of the tubes. Connecting these two drums is a nest of generating tubes on an incline. These tubes are expanded into the drum and the tube sheet and are of 1¼-in. seamless cold-drawn steel. They have just enough bend to enter the steam drum fairly.

The steam drum is 24 in. O. D. standard steel pipe while the bottom or water drum is made up of the tube sheet over which is bolted a cast semi-circular section cover plate.

The entire boiler, except the drums, is encased in a sectional sheet steel jacket, insulated with asbestos millboard. The steam drum is also insulated. Cast-iron fire and ash-pit doors are provided, as are also the necessary cleaning doors. The breeching is taken out of the rear and lowest part of the boiler top.

The boilers, it is stated, can be shipped from the shops entirely assembled and require no external brick or other setting, save the foundation piers. If preferred, the boiler can be shipped "knock-down" and assembled on the job. In that case the tubes are expanded into the drum and the tube sheet and shipped as one unit.

The manufacturer of this boiler is the same firm which for over 20 years has made the well-known marine and high pressure Seabury water-tube boiler. The company announces that it is now building a new boiler for the New Process Gasoline Co., Philadelphia, Pa., to carry 500 lbs working steam pressure.

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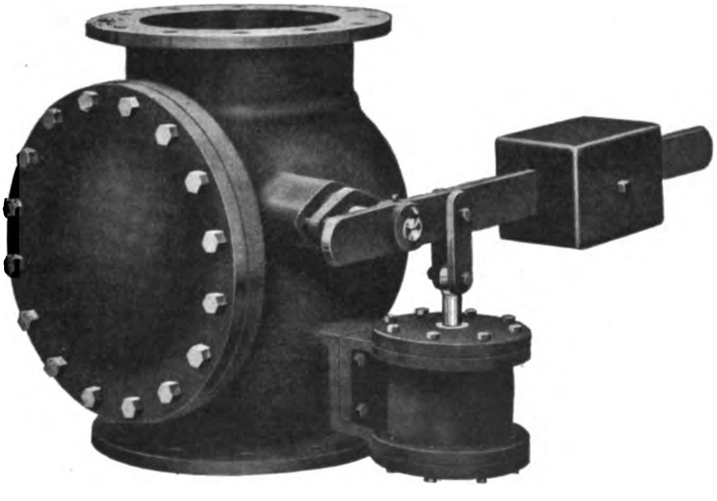
Scott Water-Sealed Automatic Back Pressure Valve.

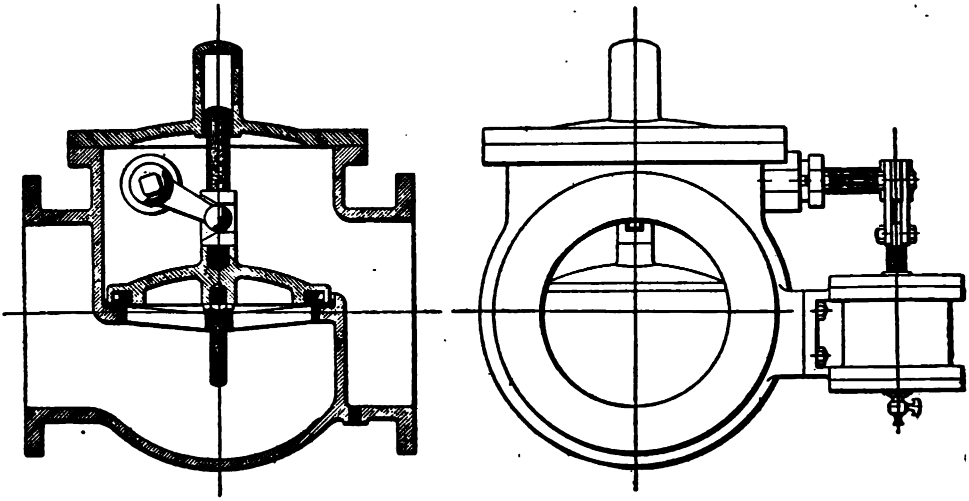
Unique construction features are to be noted in the Scott water-sealed automatic exhaust relief or back pressure valve which is especially suited for use in connection with vacuum exhaust steam heating systems. Its construction makes it easily adjustable while it is carefully designed to seat tight, thus allowing no air to enter the heating system. This valve, which is placed in exhaust main between the low pressure cylinder and the condenser, is so designed that if the condenser should fail to operate and a back pressure form in the condenser, the valve will automatically open, allowing the steam to escape into the atmosphere. All possible leakage of air, it is pointed out, which would tend to destroy the vacuum in the condenser is obviated by the water seal which is an important construction feature of the valve. In its adjustable features, the valve can be regulated to open at any desired pressure and it is declared to be quite noiseless. When used in connection with exhaust steam heating, it is constructed so that any desired amount of back pressure can be carried for this purpose.

It is made in vertical, angle and horizontal patterns, all with ample water-sealing device. Access is had to the interior simply by removing the cover, and emphasis is laid on the fact that no bolts, nuts, pins or other loose parts are used in the interior of the valve. Large outside air cushioning dash pots are used, which can be regulated to meet desired conditions, and they have been found to remain constant in cushioning effect as they are not subject to condensation or other disturbances. The main stem is guided top and bottom through bronze bushings to maintain perfect alignment so that the disc will take perfect seating and true grinding.



SCOTT AUTOMATIC BACK PRESSURE VALVE.

Xyloform Paint, described as the wall covering which can be washed when soiled, is a product of the Nash Engineering Co., South Norwalk, Conn., and is described in new circular matter. It is in the form of a powder and requires simply the mixing of cold water to prepare it for use.



HORIZONTAL TYPE SCOTT WATER-SEALED AUTOMATIC EXHAUST RELIEF OR BACK PRESSURE VALVE FOR CONDENSER OR HEATING SYSTEM.

New Type of Vacuum Cleaner.

A sanitary vacuum cleaner embracing new methods of dirt separation and its continuous automatic disposal, has just been placed on the market by the United Vacuum Appliance Company, Connersville, Ind., after three years of experimentation. This firm is well known as the manufacturer of Connersville vacuum cleaners, having succeeded the vacuum cleaning department of the Connersville Blower Company several years ago.

The most unique and valuable feature of this new machine is its centrifugal separator. As the dust-ladened air reaches the cleaner it is washed with water. By the use of a small rotor, the dirt and water are separated from the air by centrifugal force and discharged into the sewer under no pressure, during the time the machine is in operation. The washed dry air is discharged into a flue.

Because of this automatic disposal of the dirt, it is not necessary for the operator to handle sweepings; neither is it necessary to clean out tanks.

The centrifugal separating vacuum cleaner has only one valve. It is a swing check valve which opens just wide enough to discharge the water and dirt forced against it by the rotor of the separator. There is a small continuous spray of clean water entering the washing chamber so that when the tool is lifted from the floor, this water serves to cleanse the rotor and pipe line. The spray is drawn into the washing chamber from a box or tank, when the vacuum producer starts, and ceases to flow as soon as the vacuum drops to zero on shutting down the machine. This box is kept full of water by means of a ball float and valve. The float shuts off the city water supply

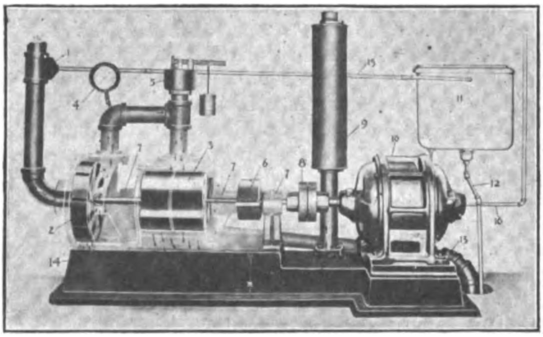


FIG. 1.—NEW TYPE OF VACUUM CLEANING MACHINE.

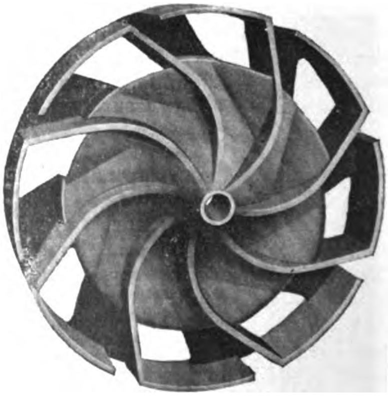


FIG. 2.—ROTOR USED WITH CENTRIFUGAL SEPARATOR.

as soon as the spray pipe ceases to draw from the box.

The water and dirt are at all times handled under high velocities, thereby preventing any deposits on the inside of the piping.

A number of machines of the centrifugal type have been sold during the past year and their performance closely watched with a view of having a perfected vacuum cleaner to offer the public when the real marketing began. The machines which have already seen service are installed in residences, public buildings, and commercial cleaning establishments with the gratifying result that they have proven practical for use wherever a vacuum cleaner is needed. For hospitals and sanatoriums these machines are particularly well designed, as the final disposal of all dirt and germs upon entering the cleaning tool is a most desirable accomplishment.

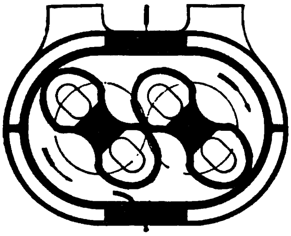


FIG. 3.—CROSS-SECTION OF VACUUM PRODUCER USED WITH NEW CONNERSVILLE VACUUM CLEANER.

One strikingly interesting piece of work to which these machines are adapted is the removal of soap suds and dirty water from rugs, carpets or bare floors which have just been scrubbed. Such work makes much more rapid and easy the scrubbing of tile and concrete floors which has formerly been accomplished by the janitor on his knees with a hand-brush.

Fig. 1 shows a phantom of the complete centrifugal unit. Fig. 2 illustrates the rotor which is the moving part of the centrifugal separator, he design of which has been the result of numerous and exhaustive tests. Fig. 3 shows the cross section of the vacuum producer which is a Connersville double-impeller rotary blower.

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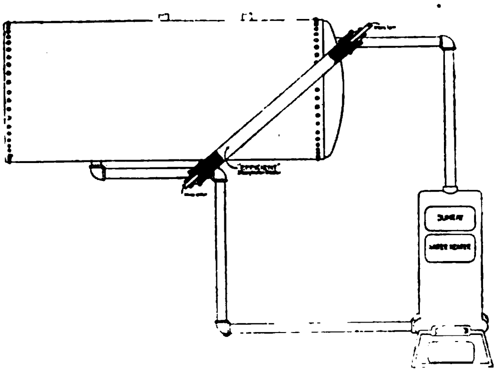
Trade Literature.

Kieley & Mueller Steam, Water and Air Specialties, for use in the connection with power, heating and plumbing installations are the subject of a new catalogue (No. 27), issued by Kieley & Mueller, Inc., New York. The company announces that the word "Kieley" enclosed in a diamond is now cast on all its specialties. The catalogue is divided into eleven sections and covers such specialties as various types of pressure regulating valves, pressure controlling devices, boiler stop and check valves, back pressure and atmospheric relief valves and exhaust heads, steam and grease separators, muffler tanks and feed water heaters. Full, but concisely arranged, information is given of each device. Special attention is called to the fact that the catalogue supersedes all previous issues. Size 6x9 in. (standard). Pp. 316.

Valve World for August, 1916, published by Crane Co., Chicago, contains the eleventh installment of the non-technical chats on iron and steel and their application to modern industry, written by L. W. Spring, the company's chief chemist and metallurgist. The August installment is a continuation of the discussion of "cast-iron."

Mott's Efficient Heater for heating water in tanks by the use of low pressure steam is illustrated and described in new circular matter sent out by the J. L. Mott Iron Works, New York. The heater may be connected with any sized tank or may be used, with an automatic regulator, without a storage tank. When connected with a tank, an automatic controlling valve can be set on the steam feed pipe to regulate the temperature of the water. The illustration shows the heater set diagonally in front of the tank. This position is necessary to bring the return pipe of the heater above the water line of the low pressure steam boiler.



MOTT'S "EFFICIENT" HEATER FOR HEATING WATER TANKS WITH STEAM.

Economy of Temperature Regulation is the subject of a timely booklet issued by the Johnson Service Co., Milwaukee, Wis., and devoted to a presentation of the actual savings effected by temperature control, in addition to the comforts obtained. Quotations are included from the works of Prof. R. C. Carpenter, Byron T. Gifford, Prof. James D.

Hoffman, Nelson S. Thompson, Prof. John R. Allen and others, supplemented by letters and opinions from well-known practicing heating engineers. In connection with the reports received from colleges and universities, instances are given by Professor Allen of the fuel savings in the University of Michigan buildings, which are heated from a central station plant, running as high as 15 per cent. of the amount of steam required for the heating system. In this connection it is pointed out that the Johnson system of heat regulation is used almost universally in the college buildings throughout the United States, and a list is given of some of the more prominent installations. The catalogue then takes up examples of fuel savings in general practice, accompanied by fac simile letters, showing savings running as high as 30 per cent. The catalogue concludes with a report of an economy test made in the Rialto building, Kansas City, Mo., published in The Heating and Ventilating Magazine for April, 1915. Size 6¾x9¾ in. Pp. 38.

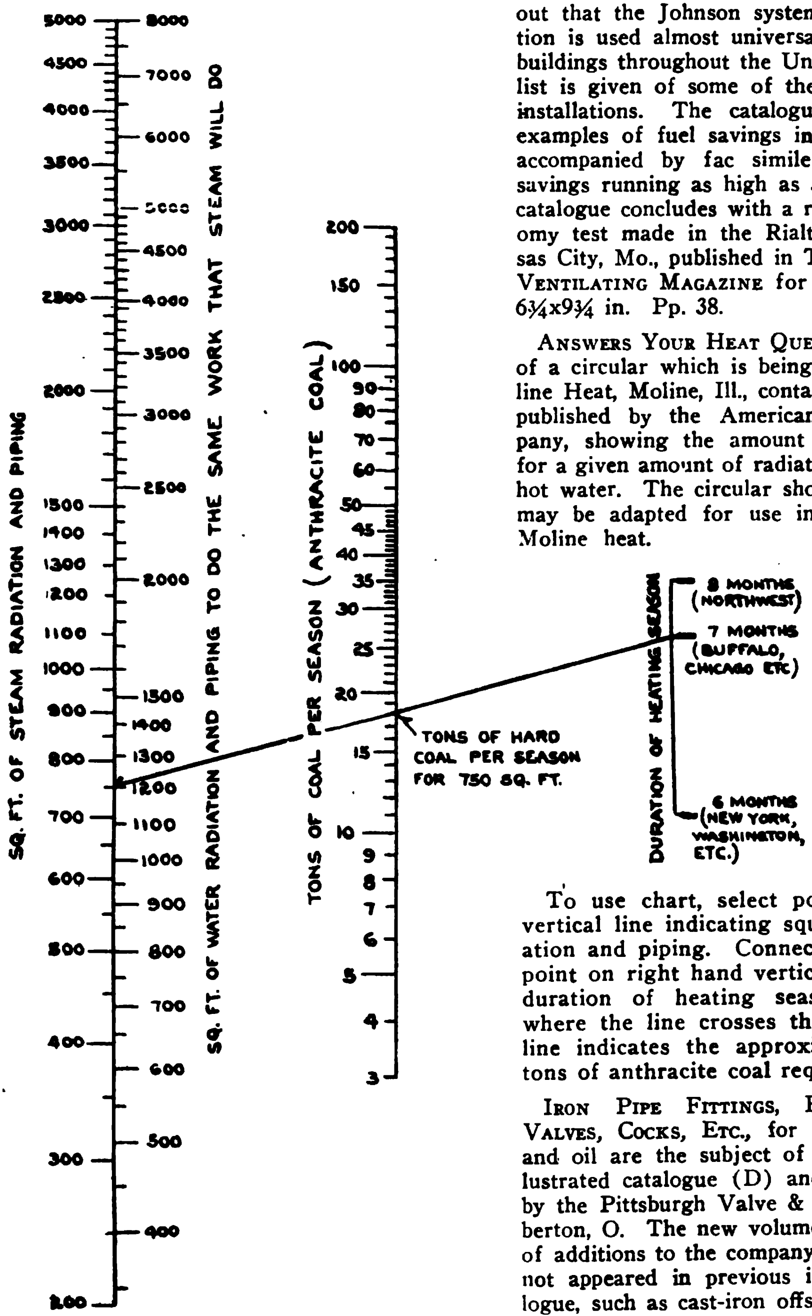


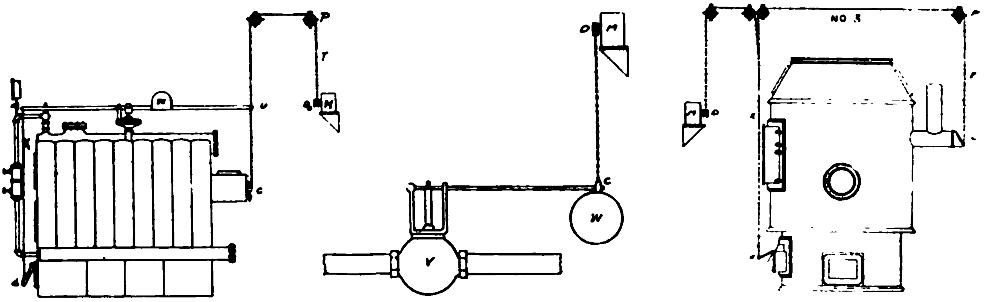
CHART FOR FIGURING AMOUNT OF COAL REQUIRED PER SEASON FOR STEAM AND HOT WATER HEATING.

Answers Your Heat Questions is the title of a circular which is being sent out by Moline Heat, Moline, Ill., containing a chart first published by the American Radiator Company, showing the amount of coal required for a given amount of radiation for steam and hot water. The circular shows how the chart may be adapted for use in connection with Moline heat.

To use chart, select point on left-hand vertical line indicating square feet of radiation and piping. Connect this point with point on right hand vertical line indicating duration of heating season. The point where the line crosses the middle vertical line indicates the approximate amount in tons of anthracite coal required per season.

Iron Pipe Fittings, Brass and Iron Valves, Cocks, Etc., for steam, gas, water and oil are the subject of a new (1916) illustrated catalogue (D) and price list issued by the Pittsburgh Valve & Fittings Co., Barberton, O. The new volume shows a number of additions to the company's line which have not appeared in previous issues of its catalogue, such as cast-iron offsets, double expansion joints, brass globe and angle valves, brass gate valves, reducing 45° cast-iron ells, 60° cast-iron ells, radiator plugs and bushings, malleable vacuum cleaner fittings, Simplex iron body gate valves and medium pressure iron body gate, globe and angle valves. Size 5x7½ in. Pp. 355.

Marvel Temperature Regulator, for controlling warm air heaters, steam boilers, hot water boilers, steam valves and gas valves, is a unique device, described and illustrated in a recently-issued circular published by the American Thermostat Co., Newark, N. J. The Marvel thermostat is a mechanical thermometer, actuated by temperature changes. It is used in connection with a special electric motor by which the heater is controlled. The non-winding motor is operated entirely by dry cells, thus eliminating the need of weights or springs. It is capable of lifting a dead weight of 25 lbs., and by adding an extra dry cell the power is materially increased. It is also furnished with a time attachment. The Marvel regulator has been found to be especially serviceable in connection with district steam control.



"MARVEL" TEMPERATURE REGULATOR INSTALLED.

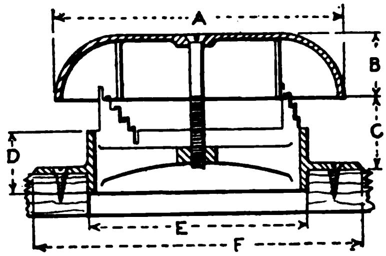
Eclipse Steam Specialties, comprising the Hughson line, formerly made by the John Davis Co., are featured in a new "pony" catalogue, issued by the Illinois Engineering Co., Chicago, Ill. This line includes reducing valves, automatic stop and check valves, back pressure valves, exhaust relief valves, separators, steam traps, balance float valves and low water alarms. The company announces that it has doubled the capacity of both its factory and bronze foundry and has retained the old skilled mechanics, assemblers and testers of the John Davis Co. Size 3½x6 in. Pp. 16.

Ja-Nar, an automatic device in the shape of a radiator covering for maintaining uniform room temperatures, is treated in an interesting catalogue received from the Fulton Co., Knoxville, Tenn. This device was formerly handled by the Annex Co., which was a subsidiary of the Fulton Co., but the Annex Co. has now been absorbed by the Fulton Co. The Ja-Nar is described as the only device which can be installed on one or more radiators, on new work or old, and one which works automatically, furnishing its own operative power without the use of compressed air, batteries, clocks, motors or other outside means. It is an insulated covering, made of furniture steel, which fits over the radiator. It has a grille, back of which are located louvres which are opened or closed automatically by a Sylphon regulator. The regulator is exposed to the room air and the louvres serve to increase or decrease the heat output of the radiator, depending on the needs of the room. The Fulton Co. is the inventor of the well-known Sylphon regulator, which is widely used in heating work in controlling the temperature of hot water boilers and tanks and for operating the draft dampers of house heating boilers and furnaces. Included in the catalogue are charts showing the temperatures obtained in a typical residence before and after the Ja-Nar was installed. Without control the inside temperature varied from 72° to 81°, while after the Ja-Nar de-

JA-NAR RADIATOR COVERING.

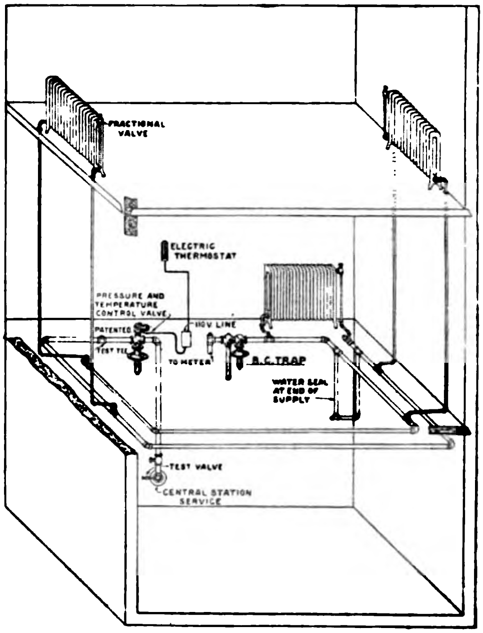
vices were in operation, there was a variation of only 1° above and below the temperature at which the Ja-Nar was set. The point is emphasized that it is not necessary to increase the radiation when installing Ja-Nars. Detail drawings are included illustrating the application of the device for different sizes and positions of radiators. Size 7x10¼ in. Pp. 20.

Ventilation Through Distribution is the title of the latest catalogue devoted to the Knowles mushroom fresh air diffusers for use with heating, cooling and ventilating systems for theaters, churches, schools, auditoriums and public buildings. They are manufactured by the Knowles Mushroom Ventilator Co., New York. In the new catalogue working drawings are presented of the various types of this device, the place of honor being given to the Knowles "Notch" air diffuser, patented June 30, 1916, which is made with set adjustments in the notches. Adjustments are made by loosening the screw, raising the hood to the desired opening corresponding with the notches on the floor piece, of which there are four, and then tightening the screw. The device is made "fool-proof" by the lock screw. It is made with either flat screw eye lugs for wood floor construction, or with drop L shape lugs extending down from the floor flange to secure the head in the cement finish of a concrete floor. It can also be supplied without lugs, but with three ⅛-in. holes drilled in the bottom shank for the purpose of riveting thimbles to the device. The other types includes the "single damper," "double damper," "lever lock," "bottom damper" and "no regulation" heads. The catalogue concludes with an important list of buildings in which the Knowles air diffusers are installed. Size 3¾x8¾ in. Pp. 16.



KNOWLES "NOTCH" AIR DIFFUSER.

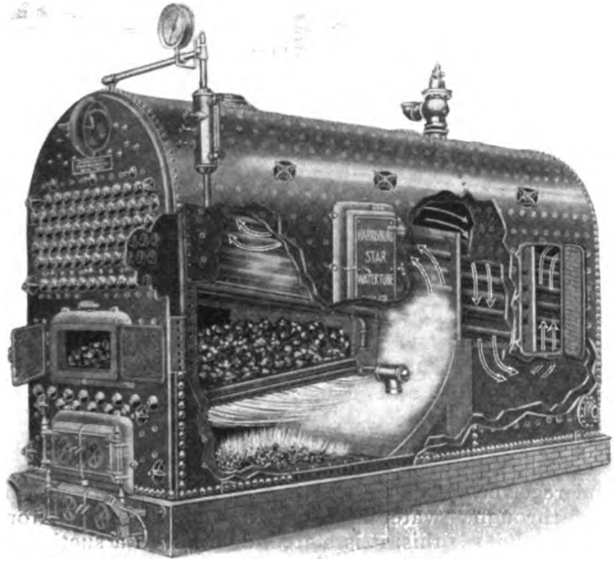
Hornung Pressure and Temperature Control Valve is featured in new circular matter received from J. C. Hornung, Chicago, Ill., engineer for central station and industrial heating and lighting. The Hornung pressure and temperature control valve is supplied with an electric thermostat for controlling the temperature in residences, stores and other buildings heated from central stations. The lowest steam pressure necessary to fill the radiator and no steam in the piping system when no heat is required are given as the combined functions of this valve. Special attention is called to the fact that usually in shutting off radiators the piping is not necessarily shut off, so that there is a definite economy possible through the use of this valve. This device is supplied in two styles and the various dimensions, etc., are included in the circular. Motors are furnished regularly for 110 volts, either A. C. or D. C.



TYPICAL INSTALLATION OF HORNUNG PRESSURE AND TEMPERATURE CONTROL VALVE.

Foxboro Thermometers, indicating and recording, are the subject of a new catalogue (Bulletin No. 104), recently issued by The Foxboro Co., Foxboro, Mass. The thermometers described are grouped in four classes: Classes 1 and 4 for temperatures from 60° F. to 250° F.; Class 2 for temperatures from 50° to 400° F.; and Class 3, for temperatures up to 900° F. The bulletin describes at length the actuating principles and the many improvements which have been embodied in the Foxboro design. Special pains have been taken in the arrangement of the catalogue to make it as easy as possible for a prospective customer to pick out a thermometer to meet his requirements. An information form is included to be filled out when making inquiries or sending orders and carefully-written directions are given for compiling the necessary data. Size 8x10½ in. (standard). Punched for binding. Pp. 56.

Star Safety Water Tube Boilers, for steam heating, hot water heating and power plants, down-draft type, are illustrated and described in a new catalogue issued by the Harrisburg Star Boiler Co., 2 East 23rd St., New York., general selling agents for the Harrisburg Mfg. & Boiler Co., Harrisburg, Pa. These boilers, it is pointed out, are designed to comply with all smoke ordinances and the laws of Massachusetts, Ohio and the cities of Detroit and Philadelphia, and also with the A. S. M. E. code. One of the principal advantages mentioned for the boiler is its ability to burn bituminous coal without offensive smoke. In this connection, a supplement to the catalogue gives the result of a test made with a Harrisburg Star boiler standing uncovered in the open air and burning two kinds of bituminous coal. The test figures which are given in detail show a smoke elimination in the two tests of 96% and 91%. Size 9 x 6 in. Pp. 32.



STAR SAFETY WATER TUBE BOILER.

Farnsworth Traps, made by the Farnsworth Mfg. Co., Boston, Mass., are the subject of a blanket folder, featuring the company's line of duplex boiler feeder traps, non-return separating traps, lifting traps, meter traps, condenser vacuum traps and vacuum traps. All of these are shown in a typical installation and their various uses described at length. Views are also included of the Southern Building, Washington, D. C., showing the duplex boiler feeder installed and the motor-driven vacuum pumps with two 15-H.P. motors which it displaced.

Vulcan Soot Cleaners for both water-tube and fire-tube boilers, in which use is made of powerful steam jets directed along diagonal paths at about 60° to the horizontal, are discussed in a new engineering catalogue issued by the Vulcan Soot Cleaner Co., Du Bois, Pa. The catalogue takes up soot formation, the effect of soot on efficiency, what soot really is, etc. Size 6 x 9 in. (standard). Pp. 91.

C & C Electric Motors, Type SL, are the subject of a new bulletin (No. 101) published by the C & C Electric & Mfg. Co., Garwood, N. J. This bulletin presents the company's well-known line of direct-current motors, which are of the four-pole interpole type, built in sizes from 1 to 125 H.P. The bulletin is well illustrated and describes the details of construction of the parts and contains a complete table of adjustable and constant speed ratings, with full dimensions of all frames. Size 8 x 10½ in. Pp. 20.

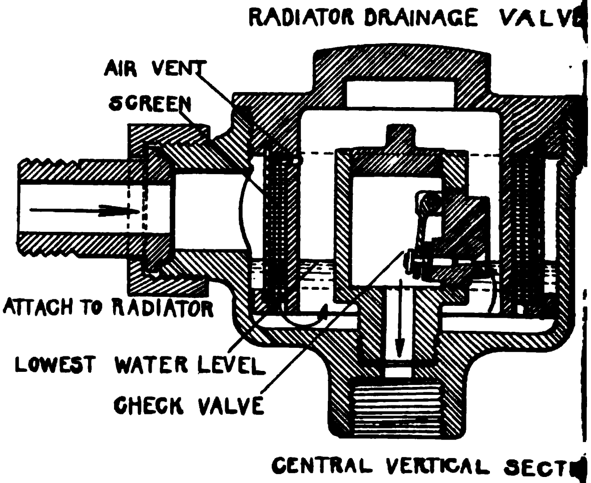
Tirrill "Equalizing" Gas Machine, for making gas automatically as wanted and for furnishing a steady supply of dependable gas of a standard, uniform quality for cooking, lighting, heating, power and industrial purposes, is the subject of a catalogue devoted to this device, which is manufactured by the Tirrill Gas Machine Lighting Co., 103 Park Ave., New York. It consists of an air pump or meter, operated by a suspended weight; the gas generator buried in the ground outside of the building to contain the gasoline, and the mixer, which is also buried in the ground near the generator. This device takes the gasoline vapor from the generator and mixes it with a given quantity of air. Size 3¼ x 8¼ in. Pp. 16.

Oil Filters is the title of a new bulletin (No. 5) recently issued by the Richardson-Phoenix Co., Milwaukee, Wis., describing that company's complete line of filters for purifying lubricating oil, having capacities of from 25 gals. to 50,000 gals. per hour. Size 8½ x 11 in. (standard). Pp. 24.

Valve World, for July, 1916, the monthly periodical of Crane Co., Chicago, discusses cast iron, in the series of non-technical chats on "Iron and Steel and Their Applications to Modern Industry," written by L. W. Spring, the company's chief chemist 'and metallurgist. The article is profusely illustrated.

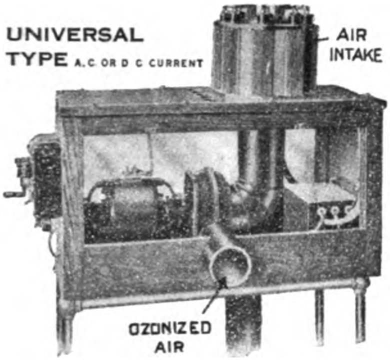
Houghton Therm System of Steam Circulation is the subject of a revised catalogue (Bulletin A) published by E. F. Houghton & Co., Philadelphia, Pa. The principal feature of this system is the Houghton Therm valve placed at the return end of each heating unit and at the drip point of supply mains, to automatically permit the passage of air and water of condensation and to prevent the escape of steam. This valve is constructed on the thermostatic principle. Its actuating mechanism is the well-known Marck tube, which is made of selected material, hollow, bent crescent-shape, and capable of withstanding great pressure. It is filled with a liquid which becomes a gas at 212° F. The vaporizing of this liquid, when steam comes in contact with it, serves to expand the tube, thus closing the valve. Other appliances used with this system include the Houghton combined float and grease trap, to take care of the entrained oil in the exhaust steam intended for the heating system; the Houghton steam pressure reducing valve; the Houghton suction strainer and condenser head, to prevent scale and dirt from being carried into the pump from the heating system; and the Houghton vacuum pump controlling valve, to maintain the vacuum at the predetermined point. This valve is attached to the vacuum pump which discharges the air and water of condensation to an air-separating tank, from which the water passes through a discharge pipe to a feed water or to a pump and receiver, the air escaping to the atmosphere through a vent in the tank. The catalogue includes a complete layout showing the use of all of these devices and additional illustrations are given of details of piping connections with this system. Size 6 x 9 in. (standard), punched for binding. Pp. 32.

Peck System of Differential Pressure Steam Heating is the subject of an interesting discussion published in circular form by Cassius C. Peck., Rochester, N. Y., the designer of this system. In its simplest expression, says the circular, this is a system of blowing through a heating circuit from a boiler to the atmosphere. When the heating system is in operation, this blowing through all radiators in use and that are filled with steam or vapor is continuous, but in case of radiators which are only partially filled with steam there is a balance of pressure and only water of condensation escapes into the return pipe. Near the return end of the heating circuit a vent pipe is provided to conduct steam and air from the return pipe through a condensing coil, or radiator, proportioned to condense all steam, the remaining air being delivered to the atmosphere. A device at the end of the vent pipe is included to prevent escape of steam and also to prevent the entrance of air into the system when the steam pressure in the boiler and in the heating circuit falls below atmospheric pressure. The trap for draining supply pipes and large radiators, as well as the radiator drainage valve used with this system, are illustrated in the circular. One of the interesting statements made is that the greatest advance in steam heating has come through maintaining lower pressure in the water return pipes than in the radiators, as this, it is stated, determined a suction effect which tends to draw water and air from radiators, this tendency being controlled by automatic valves which prevent excessive discharge. Under this condition the amount of steam in each radiator can be fully controlled by the supply valve.



THE PECK AUTOMATIC DRAINAGE VALVE.

Ozone Apparatus, formerly manufactured by the Ozone Machinery Co. of America and now handled by S. G. Hunter, 117 Twenty-second street, Des Moines, Ia., sole owner of the patent, is the subject of an interesting treatise on the air of towns, also calling attention to various types of ozone apparatus. These include the household type for alternating current only; the residence and office type, for either alternating or direct current, with capacities from 3,600 to 7,500 cu. ft. ozonized air per hour; and the universal type, alternating or direct current, built in eleven sizes, from 4 to 48 units, and with capacities from 50,000 to 700,000 cu. ft. of ozonized air per hour. Size 3½x6 in. (standard). Pp. 16.



UNIVERSAL TYPE OZONE MACHINE, A.C. OR D.C. CURRENT.

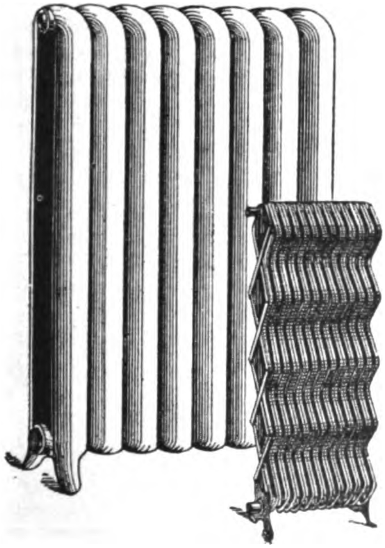
Instruments for recording carbon dioxide in flue gases, by J. F. Barkley and S. B. Flagg, is the title of a new bulletin (No. 91) published by the Bureau of Mines, Washington, D. C., It contains 60 pages, with 25 illustrations.

◆

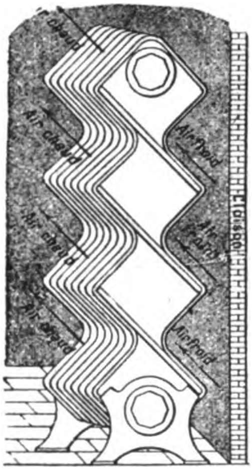
New Type of Direct Radiator.

A new form of construction for a radiator, designed to give a greater heating capacity for the same amount of surface, has been brought out in France by Charles-Elie Cabanes, 5, Rue Laffitte, Paris. We are indebted to Julien Champeaux, general manager of the company, 24, Westbere Road, West Hampstead, London, N. W., England, for the accompanying facts concerning this radiator. It is known as the Ardent and is designed especially to bring the cool air to the top as well as to the bottom of the radiator. In the ordinary type it is well known that the top of the radiator does not have as high an efficiency as the lower part, owing to the greater temperature difference between the air and the radiator at the bottom.

In the Ardent radiator construction the air is made to pass obliquely through the radiator through the use of partitions dividing the radiator into sections. In this way the air as it impinges on the sections will be practically as cool at the top as at the bottom.



"ARDENT" RADIATOR COMPARED WITH ORDINARY TYPE OF DIRECT RADIATOR.



COURSE OF AIR THROUGH "ARDENT" RADIATOR.

Besides being more effective, the advantages claimed for these radiators are that they are less cumbersome, are easier to transport and are savers of fuel. They are stated to be especially effective in the case of hot water heating, the claim being made that they increase the water circulation three times over what it is in the ordinary radiator, under similar conditions.

The Ardent is made in various heights and sections with from one to six partitions. It is made of cast iron, but it is also made of aluminum.

◆

New Boiler Wall Coating.

Engineers who have had trouble in getting perfect fuel combustion will be interested in the new boiler wall coating, known as J-M Aertite, which has been placed on the market by the H. W. Johns-Manville

Co., New York. This coating is designed to prevent air infiltration which has been a prolific source of imperfect combustion. The J-M Aertite boiler wall coating provides a tough, rubbery coating or blanket over the entire boiler setting which remains tight due to its adhesive and ductile qualities. It is applied by troweling on the outside of the boiler wall, and it is stated that the best results are obtained by keeping the thickness as near 1/16 in. as possible. When applied at this thickness, it is estimated that 25 to 40 lbs. of the coating will serve per 100 sq. ft. In a recent test of this coating, made at one of the largest power plants in New York, the results before and after J-M Aertite coating was applied showed that the amount of CO_2 was increased 2¼% after the gases had passed the first baffle, and 16.4% after the gases had passed the second baffle.

◆

Washed Recirculated Air Compares Favorably With Fresh Air.

Continued experiments with washed, recirculated air and with fresh outdoor air in one of the Bronx, New York, schools indicate that as good progress is made by children subjected to partly recirculated air as by those provided with a liberal supply of outside air. The rate of improvement recorded by both groups is decisive, but the advantage is with the children supplied with washed, recirculated air.

The experiment was conducted under the auspices of the New York State Commission on Ventilation at Public School 51, Bronx, and covered two classes for two terms, Professors Edward L. Thorndike and G. J. Rugers of the Teachers' College being in charge.

Tests were given the children in addition, cancelin numbers, canceling letters and finding and copying addresses and the results in both experiments showed an advantage in favor of the recirculated air group over the fresh air group. In the first experiment the recirculated air group gained 298.8, and the fresh air group 192.2. In the second experiment the relative figures were 191.2 and 184.8.

◆

Accounting Systems for Manufacturers and Retail Merchants.

Two booklets are being sent out by the Federal Trade Commission to merchants and manufacturers throughout the United States, one dealing with the fundamentals of a cost system for manufacturers and the other outlining a simple system of accounts for retail merchants. They have been prepared with much care and are simple and to the point.

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THE
HEATING AND VENTILATING
MAGAZINE

1123 Broadway . NEW YORK October, 1916

The Development of the Smokeless Boiler

High Efficiencies of this Type Based on Better Combustion, As Well As On Cheaper Coal, with Higher Heat Values.

By CHARLES L. COLLETTE.

About 20 years ago William Kent wrote a book called "Steam Boiler Economy." In this book he made several recommendations regarding proper methods of burning soft coal smokelessly. Even at that early date the smokeless burning of soft coal was not a new idea, but was rather something that had been done for a number of years.

Two factors were of prime importance in the development of the smokeless boiler. The scarcity of hard coals and their consequently rapid increase in price, particularly in the Middle and Western States, and the passing of various ordinances prohibiting smoke.

These two prime factors working hand in hand meant that one of two things must happen. Efficient methods for burning soft coal smokelessly must be developed or the owners of buildings were bound to find their coal costs constantly increasing, possibly to a prohibitive point.

The early engineers had no difficulty in learning the cause of smoke and it was agreed that it was due to imperfect combustion of the gases which make up the bigger proportion of the heating value of soft coals. And it was very early learned that the elimination of smoke, which could only be accomplished by the complete burning of all of the gases, meant the elimination of waste and lower coal bills.

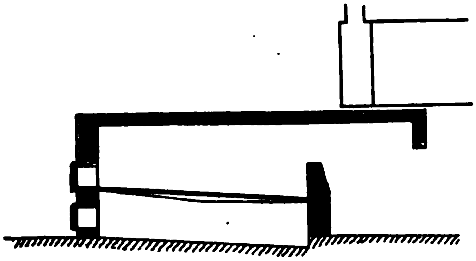
It is not difficult to see just why the ordinary type of boiler of 20 years ago could not burn soft coal efficiently or smokelessly. Practically all boilers were of the up-draft type. The coal was fed onto rocking grates of various kinds and the fresh fuel as needed was thrown on top of the fire.

The natural consequence of adding fresh fuel to the top of the fire was to produce the following result. The heat of the fire under the fresh fuel caused the gases in the fresh fuel to distill. This distillation of gases occurred in a chamber which was not hot enough to ignite these gases. Upon striking the comparatively cool water surfaces of the boiler they were condensed into smoke and passed up the stack unburned.

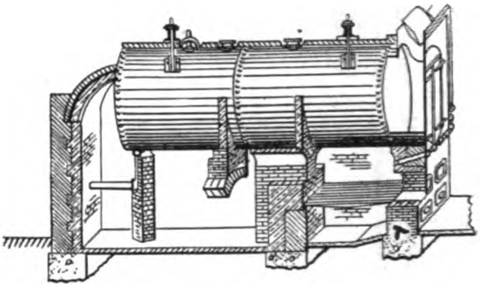
EARLY TYPES OF SETTINGS FOR OBTAINING SMOKELESS COMBUSTION.

Various arches and combination linings of fire brick were first used to solve this problem. The theory was that by surrounding the combustion chamber with fire brick it would absorb sufficient heat to keep the combustion chamber at high enough temperature to ignite the distilled gases. Various settings of tubular boilers were arranged. Dutch oven furnaces with deflector arches and, finally, furnaces equipped with Dutch ovens and deflector arches set flush with the front of the boiler.

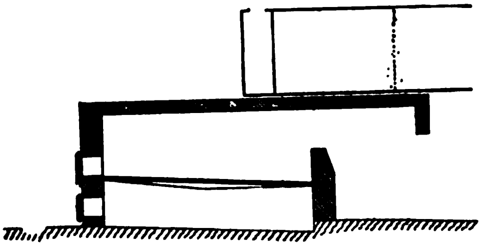
This solution did not prove practical.



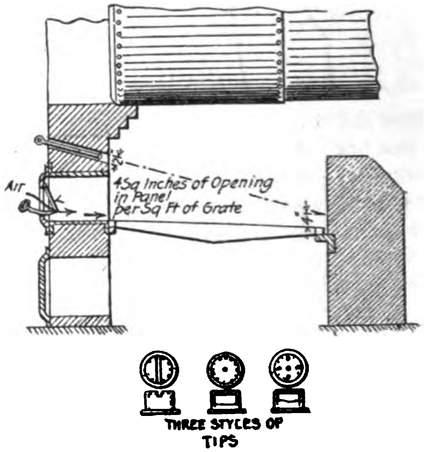
Flush Front Dutch Oven Furnace With Deflector Arch.



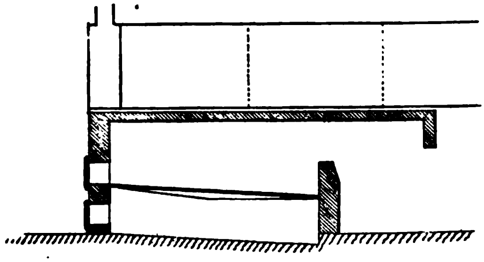
Double Arch Bridge Wall Setting for Two-Course Boiler.



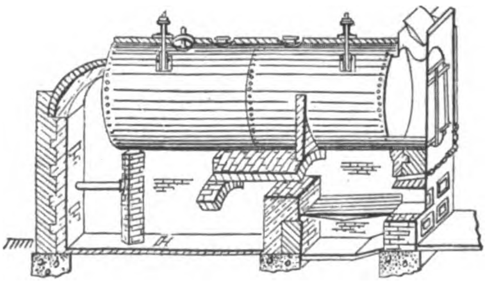
Semi-Extension Dutch Oven Furnace With Deflector Arch.



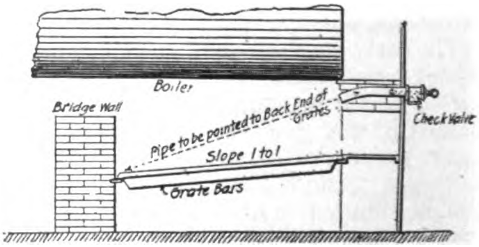
Details of Steam Jet and Panel Doors.



Full Extension Dutch Oven Furnace With Deflector Arch.



Single Arch Bridge Wall Furnace With Single-Span Deflector Arch.



Cincinnati Steam Jet for Low Settings.

VARIOUS SETTINGS OF TUBULAR BOILER TO SECURE SMOKELESS COMBUSTION.
(Compiled by Osborn Monnett, American Radiator Co., Chicago, Ill.)

It usually required more space, either in area or height, than was obtainable in the ordinary boiler room. The fire brick linings were expensive to maintain and it developed that while these various fire brick linings kept the combustion chamber at a higher temperature, it served to distill the gases from the fresh fuel more rapidly, without, in many cases, providing a temperature high enough for complete ignition of these gases.

In his book on "Steam Boiler Economy," Professor Kent makes the following recommendation, in speaking of the ordinary up-draft furnaces where fresh coal is fed on top of the fire:

"If the direction of the draft can be reversed, the air being admitted above the coal and passing down through it and through the grate, the character of the operation of the furnace is completely changed. The cold air and the cool distilled gases pass together down through the hot coke, and if the air supply is sufficient, the gases will be thoroughly burned and smoke will be prevented. To prevent the burning of the grate-bars they are made of water-tubes, which are connected by headers with the boiler so as to insure a positive circulation of the water through them."

PRINCIPLE OF HAWLEY DOWN-DRAFT FURNACE.

The down-draft princple for the complete and smokeless burning of soft coal recommended and described by Wililam Kent about 20 years ago embraces the principle of what was then known as the Hawley down-draft furnace. At that time this type of furnace had been in use for several years and had proven its ability to burn soft coal smokelessly with the consequent fuel saving.

The principle of the Hawley down-draft furnace is one which is now used by practically all makers of smokeless boilers. The firebox or combustion chamber is equipped with two grates. The upper grate, which is a water grate to prevent burning, is the firing grate. The secondary grate is below the firing grate and merely serves as a receptacle for the coked coal dropping onto it from above. The furnace is so arranged that the draft instead of passing up through the fire and then through the fresh coals; passes first through the fresh coals, then down through the fire and hot coals on the upper grate. Reversing the draft in this manner carries the freshly distilled gases down through the fire and through the hot combustion chamber between the upper and lower grates, operating to completely burn all of the gases before they come into contact with the water surfaces of the boiler.

The developments of this idea for the smokeless burning of soft coal have been many. It has been used for power and for heating purposes and furnaces and boilers have been constructed, with this principle, of both steel and cast iron. What was originally only a design for a furnace or combination chamber has been developed so that today the down-draft furnace is one of the features of various makes of boilers which combine the boiler and the furnace.

Smokeless boilers of the firebox type were out of the experimental age many years ago. They have proven particularly adaptable and efficient for the heating of larger buildings.

In the results it has achieved the smokeless boiler has well merited the approval and sanction which is now given to it by all of the leading engineers of the country. In practically every city and town of any size in this country and Canada it is burning the cheapest and poorest of soft coals smokelessly and with a decided fuel saving.

EFFICIENCY RESULTS WITH SMOKELESS BOILERS.

For a good many years engineers had agreed that 75% was the maximum efficiency which could be secured from a low pressure heating boiler. And it was quite thoroughly agreed that 60% was a little better than the efficiency of the average boiler. But actual tests of smokeless boilers have shown a much greater efficiency than has heretofore been possible.

Laboratory tests, and tests in actual installations have proven conclusively that efficiencies ranging anywhere from 70% to 80% can be obtained with unskilled labor in a smokeless boiler of the firebox type. Considering that 60% is a high average efficiency for the ordinary up-draft boiler, this shows that from 10%

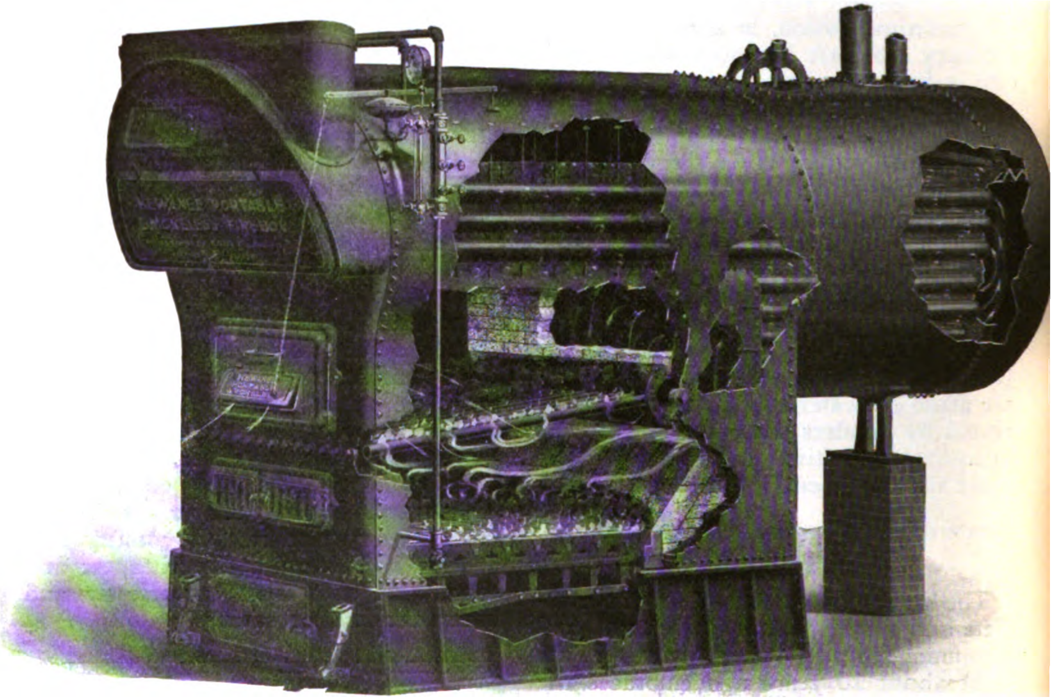
to 20% greater efficiency is possible under ordinary conditions with the smokeless type of boiler.

SOFT COAL CHEAPER AND OF HIGHER HEAT VALUE PER TON.

In addition to this saving caused by the greater efficiency in this type of boiler comes the further saving in the opportunity of using cheaper and better coal. It is a well-established fact that a dollar spent for soft coal buys more heat than the same money spent for anthracite. This means that the building owner whose building is equipped with a smokeless type of boiler can cut his coal bills in two ways. First, due to the fact that his boiler will burn any kind of soft coal smokelessly, his coal costs him less money. And the fact that his boiler is capable of burning soft coal perfectly and smokelessly insures elimination of waste and a further fuel saving. Both from the standpoint of economy in fuel and smokeless results the down-draft smokeless boiler is becoming more firmly entrenched every year.

In the latter part of 1914 the Department of Smoke Inspection in the City of Chicago started to enforce a rule that all buildings requiring 1,200 sq. ft. of steam radiation or more must be equipped with a smokeless boiler of some proven and accepted type. This ruling was rigidly enforced for a time and was then rescinded, but in a short time it was again put into effect and it is in effect today.

Undoubtedly the action of the City of Chicago is a forecast of what other big cities, and, following the big cities, the smaller cities, will do along the lines of smoke prevention. And the interesting fact is that an ordinance prohibiting smoke and demanding the installation of a smokeles boiler is not a hardship on building owners, but is rather a direct command to them to stop wasting fuel.



HAWLEY DOWN-DRAFT PRINCIPLE AS APPLIED TO KEWANEE BOILER, PORTABLE TYPE.

Burning Soft Coal Without Smoke; Also Combustion of Coals in General

By FREDERICK T. OAKES, C. E.

The question is often asked, "Can I burn soft coal without smoke?" In answer the writer would say, "Yes, under certain conditions."

In the first place, soft coal in the East is of a different grade from that used in the Middle West and West, but in either location the essentials for burning it without smoke are the amount of air taken in both under and above the grate, as well as the size of openings between the grate bars, and the space for combustion above the fire.

It is an established fact that in the burning of coal there is a gas thrown off which is not generally burned, known as carbonic oxide. The reason this is not consumed is that the oxygen in the air is used up before the surface of the fire is reached. To make up for this lack of oxygen various expedients are resorted to which are more or less successful. One of these is the well-known "Hawley down-draft," which is composed of two sets of grate bars, one above the other. The coals as they are burned drop through the upper bars to the lower bars and there meeting a fresh body of air, the carbonic oxide is burned. Another expedient is to use the ordinary grate and, by taking in air above the fire, obtain the same results. In either of these methods the success of the operation depends on the amount of air and the manner of taking in the second amount of air.

These problems have been worked out both in the laboratory and in actual practice over and over again, but for one reason or another have been abandoned, only to be revived again.

In power plants one great drawback has been graft on the part of the operators at the plant, in others, ignorance of what they were doing or unwillingness to keep the apparatus in order.

In 1865 the same principles were used in the common cooking stove and while those using them wondered at their ability to do more work and get a greater amount of heat while using less coal, this type of cooking stove finally dropped out of sight and the trade went back to the more extravagant method of throwing 40% or more of unburned fuel up the chimney.

Of late the question of getting all that is possible out of fuel has come up, as well as the proposition of using soft coal without smoke, and various heating boiler manufacturers have put out boilers which are claimed to accomplish these feats successfully.

The writer will here draw attention to a method that was used in England in the early part of the last century. Fig. 1 shows a furnace used under a power boiler burning soft coal. In this furnace the heat under the boiler was almost doubled and no smoke was emitted from the stack. Those in charge were able to reduce the size of the grate and still obtain a more steady fire than without this method. It will be observed that air was not only taken through the grate, but was also taken through the bridge into the combustion chamber.

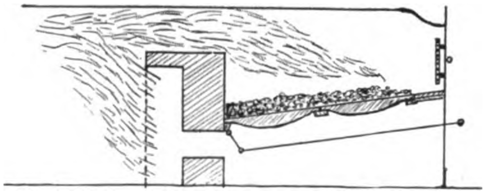


FIG. 1—OLD-TYPE FURNACE USED UNDER POWER BOILER BURNING SOFT COAL.

With the air shut off from the bridge inlet the furnace smoked as previously, but on opening the valve all smoke was eliminated and the heat output nearly doubled.

These results have been obtained many times since in a practical manner and many similar devices are in use today. The writer himself, with a very little change in a heating boiler, has effected a saving of from 10% to 40% in fuel while obtaining the same amount of heat in a number of boilers, and in one instance, made a 16-in. Menlo steam boiler.

rated at 300 sq. ft., supply the equivalent of 595 sq. ft. of direct radiation with no trouble or forcing.

In making this change a small pipe was run inside the smoke pipe, connecting it with the outer air by using a malleable iron elbow. This pipe was extended as near the boiler as posible, between the damper in the smoke pipe and the boiler. In this case the damper controlled the amount of air taken in. The draft plate below the grate was kept as nearly closed as possible, according to the amount of heat required.

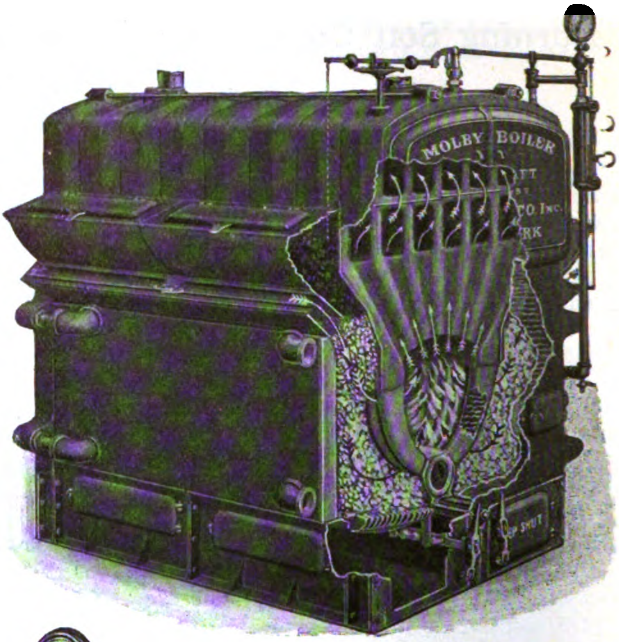


FIG. 3.

The boiler shown in Fig. 2 will burn soft coal without smoke and requires little or no attention for hours at a time. To do this the boiler is equipped with a fingered ring around the base of the fire above the grate.

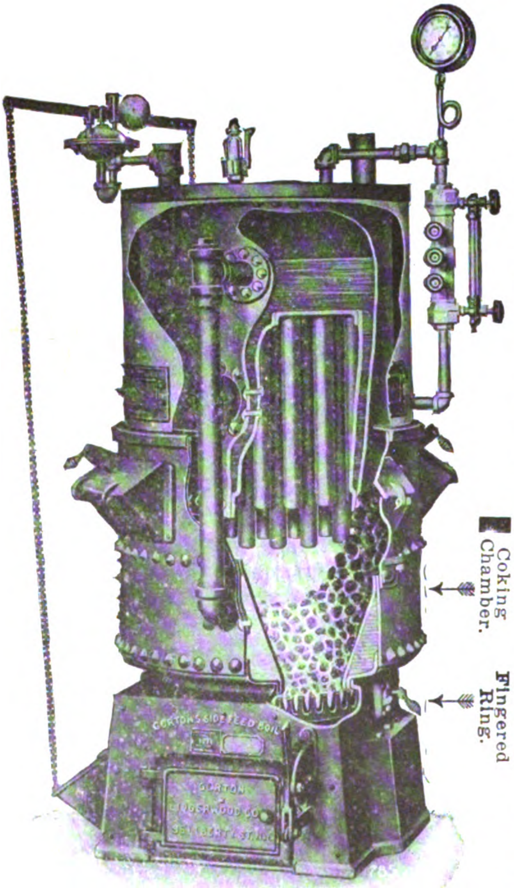

Coking Chamber.
Fingered Ring.
GORTON'S SIDE FEED BOIL

FIG. 2.

The lower part of the shell extends down into the upper part of the water leg and the space between the shell and the water leg is utilized for the coal reservoir and coking chambers. The reservoir is divided into four compartments which form coking chambers in which the coal is coked before it feeds down to the fire. The fire pot is so constructed that the claim is made that sufficient air is drawn through the fingered ring at the lower edge of the coking chamber to ignite all the gases arising from the coking process, both aiding the combustion and preventing the deposit of soot and unconsumed carbon upon the heating surface of the boiler. It is claimed there is no smoke where these boilers are used.

Fig. 3 shows another type of construction which is similar to that made by a number of manufacturers. In this type the air is drawn down through the coal and the boiler sections form an additional grate through which the products of combustion pass to the flue surfaces of the boiler. It is claimed for these boilers that there is no smoke emitted from the chimney where they are used. The arrows show the direction of the air and gases to the chimney.

In Fig.4 is illustrated the latest type of soft coal boiler, made by another well-known firm, in which there is a so-called mixing chamber beyond the bridge. The writer believes that air is brought into the mixing chamber from the outside, but the manufacturer states that this is not the case. Unless outside air is admitted to the mixing chamber the writer does not believe it practicable to consume the carbonic oxide by this method, as it is absolutely true that in order to do this, it is necessary to produce more oxygen from some point above the fire, it being very difficult to obtain sufficient air for combustion through the grate without forced draft.

In burning hard coal, the principles herein mentioned are just as necessary as when burning soft coal. In the ordinary furnace, the loss in fuel is great, all because the construction of the furnace is such that it is impossible to burn the coal most effectively. Attachments can be made similar to that used on the Menlo boiler which will, in almost all cases, result in obtaining more heat from the same fuel, or the same amount of heat with less fuel.

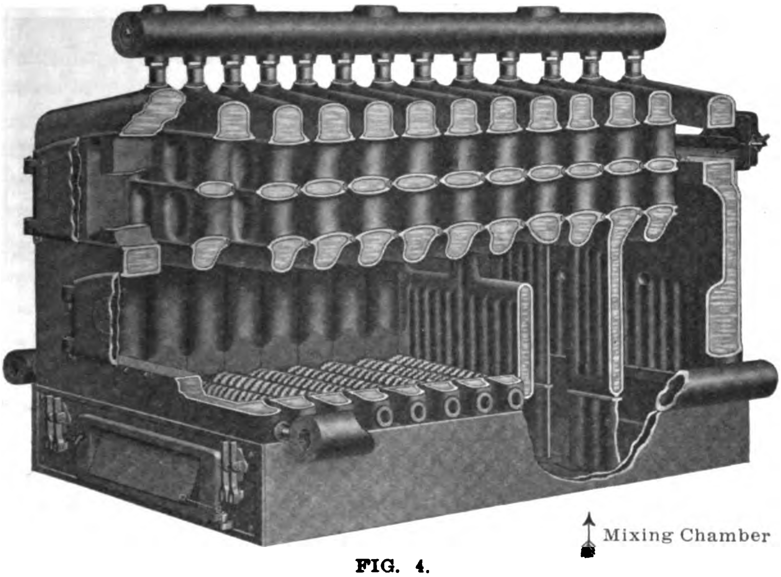


FIG. 4.

What Is Satisfactory Smoke Abatement?

By MARTIN A. ROONEY,

Chief Smoke Inspector, Smoke Inspection Department, Nashville, Tenn.

A question that deeply concerns the manufacturer of smoke abatement apparatus, the engineer and the public is: What is meant by satisfactory smoke abatement? That is, when can a given furnace stoker or smoke abating device be said to be performing satisfactorily?

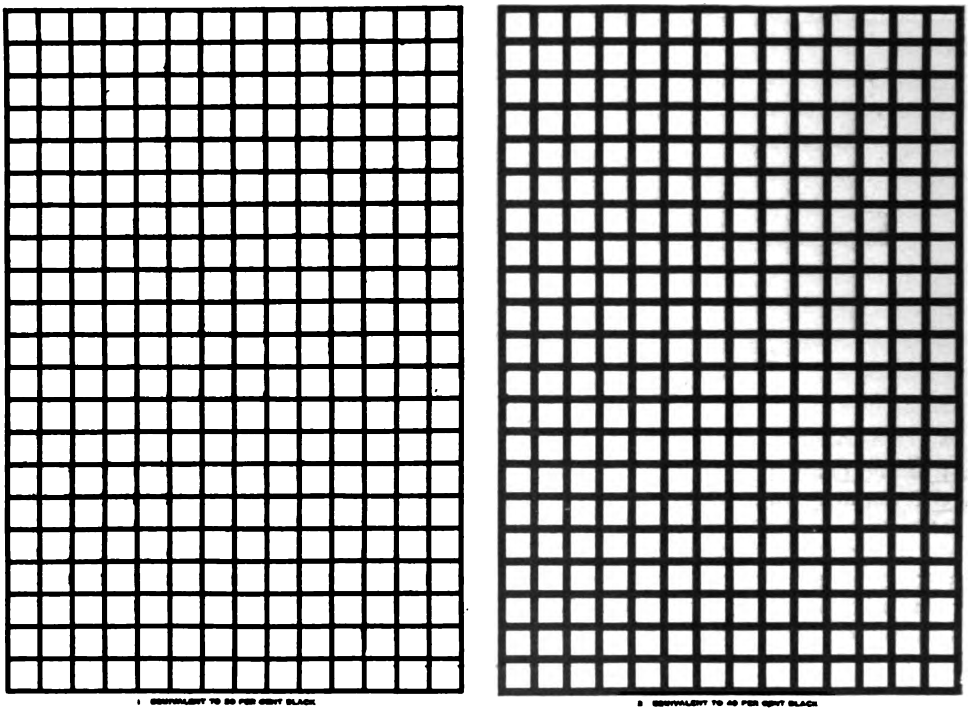
The makers' guarantees in regard to smokelessness are so at variance that it is almost impossible to compare one with another, or the guarantee is couched in such language that it is difficult to determine whether or not the furnace fulfills the guarantee after it is installed.

"Our boiler will not produce *objectionable* smoke," "Will not generate smoke," "Will comply with the Smoke Ordinance," "Will eliminate 90 per cent. of the smoke." This is the way some of the guarantees read.

There is little unanimity even among the various smoke ordinances, so that what might satisfactorily comply with the law in one city would be a hopeless offender in another. Therefore, the need of a generally understood, simple method for comparing smoke performances is becoming more and more apparent.

USE OF THE RINGELMANN SCALE.

Among the many methods suggested for measuring the color of the smoke emitted from a stack the Ringelmann scale, on account of its simplicity, has been the most generally used. This scale is used by holding the chart at such a distance from the eye that the black lines and white spaces blend into even shades of color. Then the color of smoke from the chimney is compared with the chart and the number of the scale which most nearly compares with the smoke emitted by the chimney is recorded on a suitable form. Of course, the color of smoke changes and records should be made of the color being emitted for each one-half minute or one-quarter minute period.


1 EQUIVALENT TO 20 PER CENT BLACK

2 EQUIVALENT TO 40 PER CENT BLACK

RINGELMANN'S SCALE FOR JUDGING DENSITY OF SMOKE.

Such a record would show in a graphic manner the duration of each emission of smoke from the stack during the time of observation.

Now to compare the average density of the smoke emitted by this stack with that emitted by any other stack, it is necessary to compute the average percentage density of smoke issuing from the two stacks.

This is done by the formula:

$$\text{Percentage of density} = \frac{\text{smoke units} \times 20}{\text{stack minutes}}$$

in which the various terms are defined as follows:

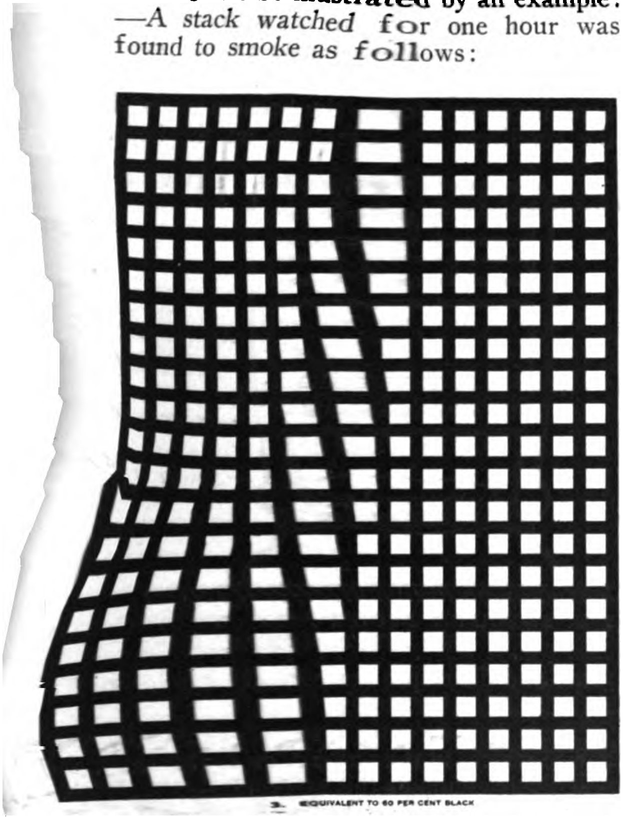
Percentage of *Density* of smoke is the percentage of light that is prevented from passing through it. For instance, number 4 smoke prevents 80% of light from passing through it; number 1 shuts off 20% of light, etc.

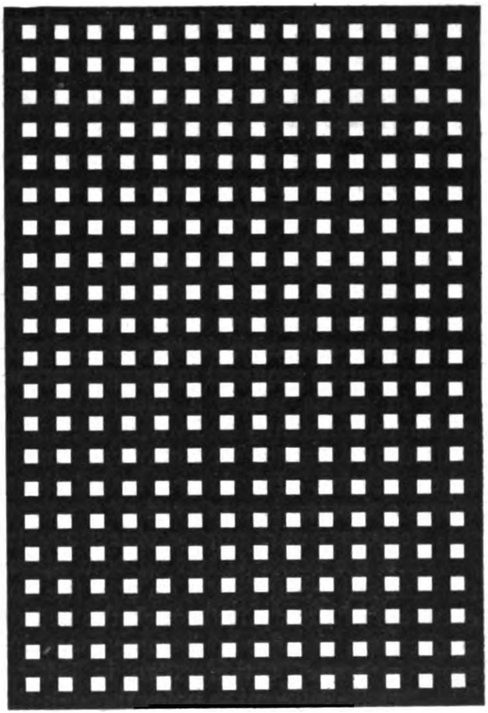
A Smoke Unit corresponds to our minute of number 1 smoke, or its equivalent. One minute of number two smoke is equivalent to two minutes of smoke number one, or equals two smoke units. Two minutes of number 3 smoke equals six smoke units, etc.

Stack Minutes mean the number of

minutes one stack is watched. That is, one stack under observation for one minute equals one stack minute, two stacks watched for ten minutes equals twenty stack minutes.

This can be illustrated by an example:—A stack watched for one hour was found to smoke as follows:


3. EQUIVALENT TO 60 PER CENT BLACK


4. EQUIVALENT TO 80 PER CENT BLACK

RINGELMANN'S SCALE FOR JUDGING DENSITY OF SMOKE.

Number 5 (dense black) smoke, 2 min.
Number 4 smoke, 1½ min.
Number 3 smoke, None.
Number 2 smoke, 2½ min.
Number 1 smoke, 5 min.
No smoke 49 min.

This is equivalent to:—

5 × 2 = 10 units
4 × 1½ = 6 units
3 × 0 = 0 units
2 × 2½ = 5 units
1 × 5 = 5 units

A total of 26 units. One stack observed for an hour is equivalent to sixty stack minutes. Therefore the percentage of density equals

$$\frac{26 \times 20}{60} = 8^2/_3\%.$$

Now a stack may be said to be performing satisfactorily when it *emits not more than 3 minutes of dense smoke (number 3 or greater) in any one hour and when the average percentage density of the smoke emitted in one hour is not greater than 5%.*

After experience with hundreds of smoke preventing devices of all kinds it is the writer's opinion that the above standard is readily obtainable by any type of smoke preventing furnace worthy of the name.

An Arrangement for Maintaining Even Combustion in Down-Draft Boilers

By CHARLES A. FULLER.

Owing to the steadily advancing prices of anthracite coal there has come a demand for a boiler for low-pressure heating, which will burn the cheaper grades of coal, particularly in the large cities, where the heating of apartment houses and business buildings adds considerably to the expense of overhead charges, consequently cutting down the interest on the investment. This demand has been met by the comparatively large number of smokeless down-draft boilers, designed to burn bituminous coal.

The down-draft type, however, has its disadvantages. One of the chief objections to the standard type, when made without the magazine feature, is the constant attention required in firing, particularly in plants where a fireman is not employed constantly and where the boiler is fired by a janitor who may have many other duties. In large installations, where a fireman is employed all the time, this feature would not be objectionable.

When the boiler is left without attention for any great length of time the unevenness of the draft through the bed of coal causes the fire to become more intense in some portions than in others. This results in burning holes through the bed of coal on the upper grate, which, of course, reduces the efficiency of combustion. The intensity of the draft through these holes causes cinders to be drawn through and up the chimney. It is, therefore, necessary for the fireman to watch the condition of the fire on the upper grate and distribute the coal to avoid the formation of these holes.

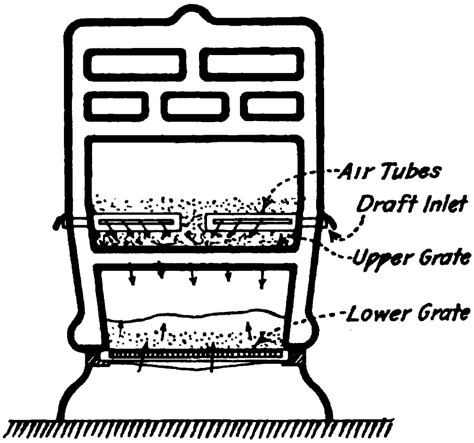


FIG. 2—BOILER EQUIPPED WITH SLOTTED AIR TUBES.

There has recently been developed a device which, in the writer's opinion, will practically eliminate this trouble. It consists of a slotted air tube placed across

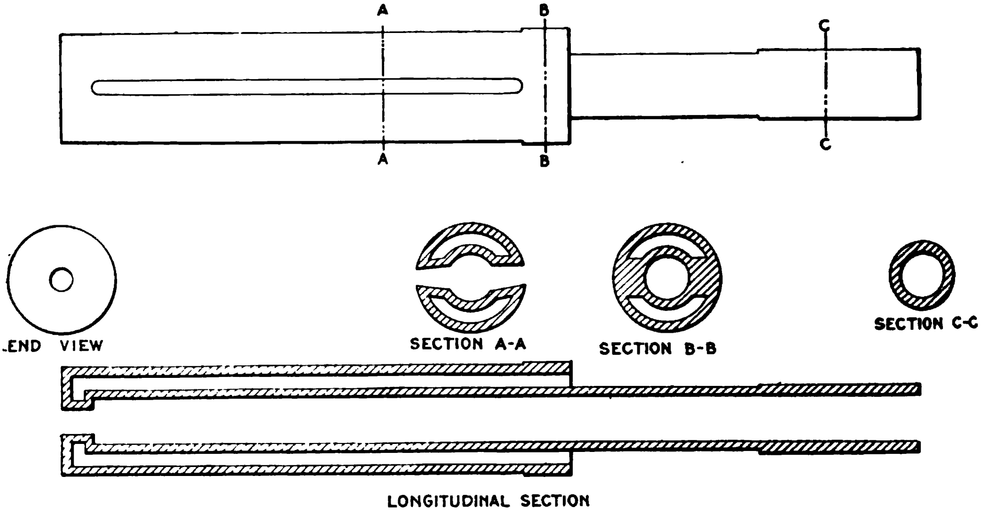


FIG. 1—CROSS SECTION AND LONGITUDINAL SECTION OF SLOTTED AIR TUBES FOR MAINTAINING EVEN COMBUSTION IN DOWN-DRAFT BOILERS.

the upper grate and about 6 in. above the top surface of the grate.

Fig. 1 shows a side view cross-section and longitudinal section through the tubes. The air enters from the side of the boiler, passing through the center opening and out into the bed of coal through the two openings on the side. The circular space between the air chamber and the outside is for a water jacket to prevent the burning of the tube.

Fig. 2 shows the application of the tube to the standard cast-iron sectional boiler. There are two tubes for each section, one inserted on each side with a space of about 6 in. between the ends of the tubes. The control of the draft is obtained by means of small check dampers, at the exposed ends, operating in unison.

In addition to providing an even distribution of air over the fire the tubes prevent the cold air from the outside coming in contact with the heating surface above the fire-box. The tubes also permit of a large quantity of coal being placed on the upper grates at one time without interfering in any way with either the draft or the efficiency of the combustion.

Things to Remember About Chimneys

BY E. C. MOLBY.

It is well know that the area, the height, and the construction of a chimney flue is of the greatest moment to the boiler manufacturer, the steam fitter and to the house owner.

In the construction of a chimney in connection with a power plant, the areas and construction of that chimney are very carefully figured out by the engineer to take care of the work that is to be placed on it.

In the construction of a chimney flue for a heating boiler, very little attention ordinarily is given to its suitability for the work in hand. The chimney has usually been assigned whatever space has been left after the arrangement of the rooms has been decided.

At the present time, however, there has been a great improvement on the construction of chimney flues for heating boilers, but generally flues are still constructed along the old lines that an 8-in. flue is big enough for any heating boiler, and wherever the flue has been put in with 8-in. tile, which is less than 7 in. square inside, in only a few instances has this area been sufficient to give proper combustion for the boiler placed on it.

It can be proved that there have been more boilers condemned on account of poor chimneys or poor draft than for any other reason. When the owner burned a paper in the bottom of the flue and because the flame went up the flue he has contended that his chimney was perfectly good and everything that could be desired. This does not prove the volume of the flue, only shows velocity, not capacity, and is in no sense a test of the flue or flue conditions.

A chimney flue should be of sufficient area and height to give to the boiler volume of air for the proper burning and combustion of your fuel, and should be constructed in each case according to the heating requirements. A high flue of small area is equal to a low flue of large diameter on account of its greater velocity.

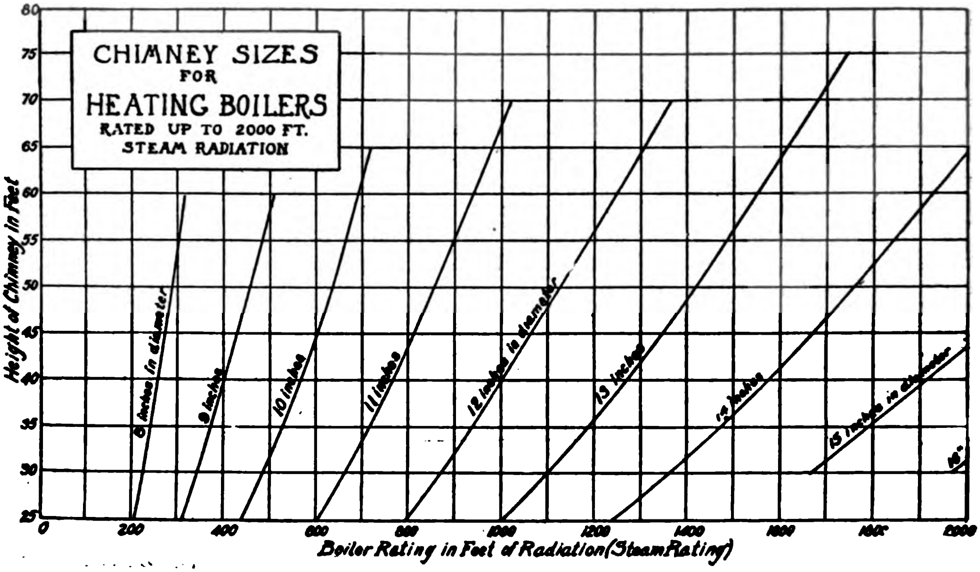
The flue should be round preferably, or square as a second choice, and should never be oblong except that it is of good proportion and not very narrow nor very long.

The flue should be straight, without offsets, and where tile lined, the joints should be carefully cemented, and the ordinary brick flue should be plastered or pointed smooth on the inside to close all openings and prevent leakage.

A separate flue should be built for each stove, fire place, or boiler, except that one flue can be used for a battery of boilers in which case tight fitting dampers should be placed in each smoke connection.

Two chimneys should not be connected at the bottom as is often done, but each flue should run separately and be distinct in all its parts from the bottom to the top.

The flue should be high enough above



its surroundings to avoid back drafts from currents of air over the roof or surrounding buildings, and in many cases trees covering too close over a chimney will affect its draft.

In the construction of flues, many times the builder will put two flues in one chimney and fail to grout in between the tiles so that the two flues are connected between the sections of tile from top to bottom. To avoid this there should be a partition between the tile flues, and the spaces around the tile grouted in with mortar.

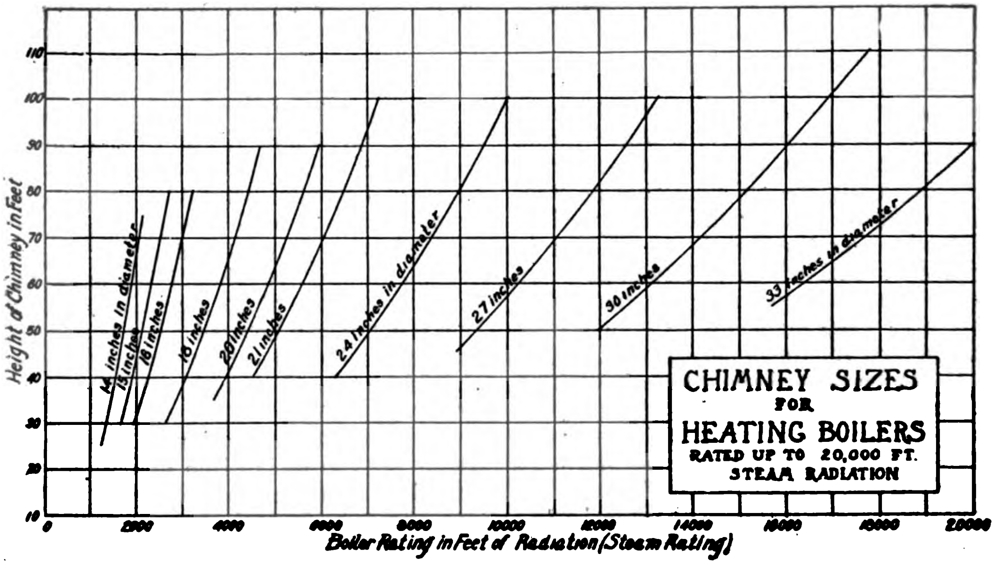
The flues should be so built that all of the air that passes into them passes through the boiler.

The smoke connection from boiler to chimney should be carefully cemented.

The clean-out door at the bottom of the flue should be tight.

In case of more than one flue in a chimney there should be no leakage from one to the other. Two flues should not enter into the same clean-out chamber.

A chimney flue should have straight sides, and not enter into some old fire place opening, but should be carried di-



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rectly through such opening and of the same dimensions as the flue above and below it.

In connection with the accompanying charts which were originally compiled by the H. B. Smith Company, Westfield, Mass., and published in Lefax, Philadelphia, for March, 1916, it should be borne in mind that with small sizes of coal for thick beds of fuel, taller chimneys are needed than with large sizes or for thin beds. Conversely, with tall chimneys, small sizes of coal should ordinarily be used.

In cases where the smoke pipe opening on the boiler is smaller than the chimney flue called for in the charts, it is desirable, especially with long smoke pipes, to bring the diameter of the smoke pipe or breeching up to within an inch or two of the diameter of the chimney, and to do this as close as possible to the smoke bonnet. The enlargement of the smoke pipe should be a gradual one.

When two or more boilers are connected to one chimney the sum of the ratings of all the boilers that may be in operation at one time should be used in determining the size of the chimney. The breeching should increase gradually in size as the individual smoke pipes enter it.

As the inside dimensions of brick flues and tile flue linings do not correspond to their so-called "commercial sizes," the accompanying table is given to show their actual inside cross-section area, together with the area of circular flues or smoke pipes.

BRICK FLUES, TILE FLUE LINING AND CIRCULAR FLUES.

Actual Inside Cross-Section Area of Commercial Sizes.

Brick Flue, Unlined, In.	Tile Flue Lining, In.	Circular Flue or Smoke Pipe, In. Diam.	Cross-Section Area, Sq. Ft.
......	....	8	50
......	8½×8½	..	52
......	....	9	64
8×8	....	..	72
......	....	10	78
......	8½×13	..	80
......	....	11	95
8×12	....	..	110
......	....	12	113
......	13×13	..	126
......	....	13	133
......	....	14	154
12×12	13×18	..	169
......	....	15	177
......	....	16	201
12×16	....	..	221
......	....	17	227
......	18×18	..	240
......	....	18	254
......	....	19	283
16×16	....	..	289
......	....	20	314
......	....	21	346
16×20	....	..	365
......	....	22	380
......	....	23	415
20×20	....	..	450
......	....	24	452
......	....	25	491
20×24	....	26	530
......	....	27	572
......	....	28	616
24×24	....	..	640
......	....	29	660
......	....	30	707
24×28	....	..	750
......	....	31	755
......	....	32	804
......	....	33	855
28×28	....	..	880

Smoke Prevention Codes for Large and Small Cities

Occasional requests from our readers for a model smoke ordinance that will serve for both large and small cities has brought out the information that such a code may be drawn up that will apply primarily to the small city, but which may be adapted, with slight modifications, to cities of any size.

The following typical ordinance, designed to meet the requirements of the small city, was drawn up by Osborn Monnett, of the American Radiator Company, formerly smoke inspector for the Chicago Smoke Inspection Department.

The ordinance as presented may be easily modified to the uses of a large city. In that case it would call for a chief assistant smoke inspector and several deputies, according to the size of the force that was desired to use.

With a larger staff of engineers the ordinance should also have a clause incorporating the requirement that installations be followed up for a test run made under operating conditions to decide whether or not the plant was satisfactory from the smoke standpoint. In the event that it was not, alterations should be made. After the plant was determined to be satisfactory, then a certificate of operation would be issued, fee for which would be included in the original permit fee.

Following is the model ordinance in full for a small city:

AN ORDINANCE PROVIDING FOR SMOKE INSPECTION AND ABATEMENT ESPECIALLY ADAPTED FOR A SMALL CITY.

AN ORDINANCE.

Providing for smoke inspection and abatement in the City of ——————————.

Be it ordained by the City Council of the City of —————————— as follows:

SECTION 1. There is hereby created the office of smoke inspector, the compensation and duties connected therewith to be as hereinafter specified.

SECTION 2. The smoke inspector shall be appointed by the Mayor by and with the consent of the City Council, and shall perform the duties of his office until removed from office by the Mayor or until the Mayor by and with the consent of the City Council has appointed his successor.

SECTION 3. The person so appointed shall be an engineer, qualified by training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention.

SECTION 4. The salary of the smoke inspector shall be —————————— dollars ($) per annum.

SECTION 5. The said inspector is authorized to employ one clerk, to be selected from the civil service list of the city and the clerk shall attend to such duties as the inspector shall direct and be paid according to civil service rating in the manner fixed by law.

SECTION 6. The Mayor shall appoint a smoke abatement commission composed of three representative citizens, one of whom shall be a mechanical engineer of recognized standing, who shall act without remuneration as advisors to the Mayor and to the smoke inspector on matters pertaining to the organization or the conduct of the smoke abatement work, or both. The smoke inspector shall at all times receive and place on file all suggestions, recommendations, advice, or other communications that may be submitted to him in writing by the smoke abatement commission.

SECTION 7. No new plants or any reconstruction of any old plants for producing power and heat, or either of them, except for detached private residences, or for buildings used exclusively for private residence purposes, in which the number of families occupying apartments shall be less than six, shall be erected or maintained in the city until plans and specifications of the same have been filed in the office of and approved by the smoke inspector and a permit issued by him for such erection, reconstruction or maintenance. The plans and specifications to be filed with the smoke inspector shall show the amount of work and the amount of heating to be done by such plant and all appurtenances thereto, including all provisions made for the purpose of securing complete combustion of the fuel to be used, for the purpose of preventing smoke; said plans and specifications shall also contain a statement of the kind of fuel proposed to be used, including the commercial size of coal when such fuel is specified, and said plans and specifications shall also show that the room, apartment or basement in which such plant shall be located is provided with doors, windows, air shafts, fans and other means of ventilation sufficient to prevent the temperature of such room, apartment, basement or other portion of such building wherein such plant or apparatus is to be used, from rising to a point higher than 120 degrees Fahrenheit; and sufficient also to provide that the atmosphere of any such room, apartment or basement wherein such apparatus may be located, may be entirely renewed every ten minutes.

Upon the approval of such plans and specifications, a duplicate set of which shall be left on file in said office, and upon the payment of the fees hereinafter provided, the smoke inspector shall issue a permit for the construction, erection or maintenance of such plant. As soon as the smoke inspector has examined the plans and specifications submitted and has issued a permit as above provided, he shall then notify the Commissioner of Buildings to see that the execution of the work permitted is carried out in conformity with the plans and specifications, with special reference to the amount of space used, the size and construction of the chimney or chimneys used, the provision for the prevention of smoke and the provision for ventilation, and the proper temperature in the room, apartment or basement.

SECTION 8. It shall be unlawful for any person to use any new or reconstructed plant for the production and generation of power and heat, or either of them, except for detached private residences or buildings used exclusively for private residence purposes in which the number of families occupying apartments shall be less than six, until he shall first have procured a statement from the smoke inspector that the plant is constructed in accordance with the plans and specifications filed with the smoke inspector at the time the permit was issued.

SECTION 9. No owner, lessee, or operator of any existing plant shall alter or repair any chimney or any old furnace or device, which alteration, change or installation shall affect the method or efficiency of preventing smoke, without first submitting plans and specifications to the smoke inspector and securing a permit therefor; however, that minor necessary or emergency repairs which do not change the capacity of such plant or which do not involve any substantial alteration in structure and which do not involve any alteration in the method or efficiency of smoke prevention may be made by or under the engineer in charge of said plant without a permit. Any person who shall violate sections 7, 8 or 9 shall be liable to a fine of $25.00 for each day upon which he shall prosecute such erection, construction, alteration, change or installation, or use any new or reconstructed plant without a permit, and each day's violation shall constitute a separate offense.

SECTION 10. The emission of dense smoke within the city from the smokestack of any locomotive, steamboat, or steam tug for a period of more than one minute, except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein, is hereby declared a nuisance.

The emission of dense smoke within the city from the smokestack of any steam roller, steam derrick, steam pile driver, tar kettle or other machine or contrivance, or from the smokestack or chimney of any building or premises, or from any open bonfire, open bin, tank, vat, basin or other receptacle except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein is hereby declared a nuisance.

Any nuisance such as the above specified may be summarily abated by the smoke inspector, or by anyone whom he may duly authorize for the purpose, and such abatement may be in addition to the fine hereinafter provided.

Any person or persons, or corporation owning, operating, or in charge or control of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or any open bonfire, open bin, tank, vat, basin or other receptacle, or of any building or premises, who shall cause or permit the emission of dense smoke within the city, in contravention of the provision of this section, from the smokestack of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or from any open bonfire, open bin, tank, vat, basin, or other receptacle, or from the smokestack or chimney of any building or premises so owned, controlled, or in charge of him, her, or them, shall be deemed guilty of a violation of the ordinance, and upon conviction thereof shall be fined not less than ten dollars ($10.00) nor no more than one hundred dollars ($100.00) for each offense; and each day of such emission of dense smoke shall constitute a separate offense.

For the purpose of grading the density of smoke, the Ringelmann smoke chart, as published and used by the Federal Bureau of Mines, shall be the standard of comparison. Smoke shall be considered "dense" when it is of equal or greater density than No. 3 of the chart.

SECTION 11. A fee of one dollar ($1) shall be charged for the inspection of plans and specifications for the erection, reconstruction, or alteration of any plant, this fee to include the issuing of a permit, in case such permit is granted.

The smoke inspector may and he is hereby directed and instructed to remit all inspection or examination fees charged, or that hereafter may be charged, against any and all charitable, religious, and educational institutions when the furnace or other device or apparatus inspected is located in or upon premises used and occupied exclusively by such charitable, religious, or educational institutions; provided, that such charitable, religious, or educational institution is not conducted or carried on for private gain or profit; and provided further, that the smoke inspector may require every application for the remission of such fees to be verified by the affidavit of one or more taxpayers of the city.

SECTION 12. Prosecution for all violations of this ordinance shall be instituted by the smoke inspector and shall be prosecuted in the name of the City of ————.

The issuance and delivery by the smoke inspector of any permits for the construction or reconstruction, or any permit for the alteration or repair of any plant or chimney connected with a plant, or the exemption of any class of buildings from the necessity of taking out a permit, shall not be held to exempt any person or corporation to whom any such permit has been issued or delivered, or who has been exempt from such permit, from prosecution on account of the emission or issuance of dense smoke caused or permitted by any such person or corporation.

SECTION 13. Any person who shall violate any of the provisions of this ordinance (except as is herein otherwise provided) shall be fined not less than $25 nor more than $100 for each offense.

SECTION 14. The City shall provide such instruments, books, papers, and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment, and shall deliver same to his successor in office.

SECTION 15. The smoke inspector shall cause to be kept in his office a complete record of all permits issued and of all examinations of plants made by members of the department and also of all certificates issued.

SECTION 16. The smoke inspector shall make a report of the work of his department to the Mayor and City Council, annually, on or before the first day of February, and at other times as often as required by the City Council.

SECTION 17. If any person on behalf of the City under the provisions of this chapter shall take or receive any money or any valuable thing for the purpose of favoring any person or persons, he shall be dismissed from the service.

SECTION 18. This ordinance shall take effect on and after its passage and publication.

Notes on the Rise of the Smokeless Boiler

The use of down-draft furnaces for power boilers for burning soft coal has been common for many years, and the type adopted by nearly all the heating boiler manufacturers is the Hawley down-draft furnace, with upper grate of water tubes for coking the coal, and lower grate for burning the coked fuel after the volatile products have been distilled. This method was used in Boston years ago for getting rid of smoke, and for burning cheaper soft coal, mainly for power purposes, in office building plants.

Naturally, it requires more draft to pass the air and gases through the two beds of fuel where the coal is so finely divided as is the case with a large portion of the soft coals. These furnaces were patented by Hawley, and good prices were paid as royalties for their use. As a rule they were fairly satisfactory where the fires were not forced, as if the coal was not properly coked on the upper grate or if there were holes in the fuel bed, there was likely to be smoke at the top of the stack.

Nearly every expedient was tried to overcome the smoke incident to the use of soft coal, but at first the possible economy in burning soft rather than hard coal was not thought of outside of the initial cost of the fuel. One scheme was to install steam pipes in front of the boilers with jets through which steam flowed when the doors were opened to replenish the fires. This scheme was fathered by two jewelers in Providence, who obtained control of such patents as existed. Where adopted the users were able to obtain immunity from the city fathers for the use of soft coal. The charge for the installation of the steam jets was $400 for a few feet of ¾-in. pipe, and a land office business was done for some years in the sale of the device. It often happened, however, that the apparatus was shut off except when the smoke inspector put in an appearance, but immunity from censure was generally obtained when the steam pipes in the boiler front were exhibited.

Another efficient method used with horizontal tubular boilers was a grille of fire-brick in the back connection. This became very hot or incandescent, and served to consume the smoke as it passed to the flue.

HOW SOFT COAL MAY BE BURNED SMOKELESSLY ON FLAT GRATES.

As a matter of fact, soft coal can be fired without smoke in a regular flat grate, if the fireman is careful and is not required to force the fire. By shoveling the green coal at the front and allowing it to coke before being pushed back on the grate, the gases distilled from the green coal will be consumed by the fire at the rear. After the coal is coked, it is pushed back on the grate, and the operation repeated. In all these methods, however, forcing the fire will cause smoke.

SMOKING CHIMNEYS NOT NECESSARILY INEFFICIENT.

A great deal has been said and written about the loss and inefficiency of a smoking chimney. Judged from that standpoint alone, it must be admitted that the blackest smoke contains but a small percentage of the entire amount of fuel. Firemen will frequently state that they can make steam faster, and keep the pressure up better when the boiler flue smokes or when the smoke consumer is shut off, especially if he is using steam.

This is partly true, as when there is no smoke there is no radiant carbon in the gases, and the gases have to be brought in direct contact with the heating surfaces. The radiant particles of carbon give up their heat without being in such direct contact, which accounts for the firemen's statement.

On the other hand, when the furnace smokes the flues and passages become clogged with soot, insulating the boiler surfaces, and giving the firemen a highly unattractive job in cleaning the boiler.

There is no good reason why the down-draft furnace boilers should not be successful in reducing the high cost of living.

The main objection to the use of soft coal in a small installation is the coal itself, with its dust and dirt, and not the difficulty in burning it. In the case of larger buildings, where proper provision is made for the handling of the coal, this objection does not apply, and here lies, perhaps, the largest field of usefulness for the down-draft heating boiler.

Comparison of Various Methods of Figuring Duct and Flue Sizes

Standard Practice as Developed in Six Well-Known Engineering Offices.

By HAROLD L. ALT.

One of the most interesting subjects in heating and ventilation work involves the methods used to obtain the size of the flues and ducts for a given system to produce certain required results. In order to make a comparison of the various schemes used by recognized authorities the problem shown in Fig. 1 has been worked out by the various methods, the results shown and the amount of computation indicated.

For the purpose of demonstrating all the conditions usually encountered, the problem shown in Fig. 1 involves supplying 1,500 cu. ft. of air to each of 16 outlets, located as shown, from a fan placed at the left hand end. It is assumed that these outlets are in different rooms but that air requirements are the same—or, if the air is used for heating, that the heat requirements are identical.

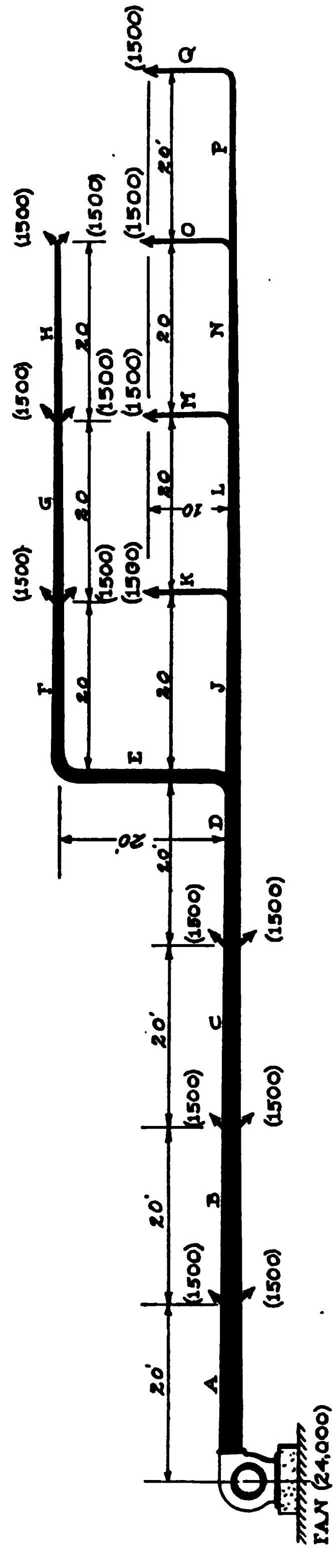


FIG. 1—PROBLEM ON WHICH CALCULATIONS WERE BASED.

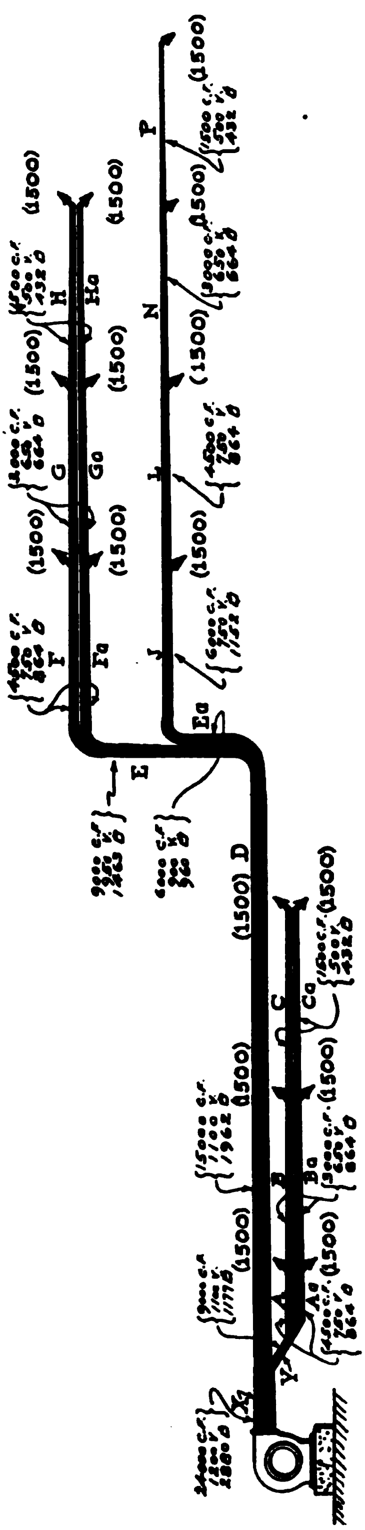


FIG. 2—SOLUTION OF PROBLEM ACCORDING TO METHOD OF WRITER.

METHOD USED BY THE WRITER.

The writer uses the following method: Assume velocities in the ducts ranging from 1,000 ft. per minute at the fan down to 500 ft. per minute in mains P and H. Size the ducts on the basis of the area required to pass the given quantity of air at the given velocity. Size flues on the basis of 400 ft. per minute velocity; size the registers on the basis of 250 ft. per minute velocity through the free area.

This gives a schedule of sizes as shown in Table 1.

TABLE 1—SOLUTION OF PROBLEM SHOWN IN FIG. 1, ACCORDING TO METHOD USED BY WRITER.

Duct or Flue	Length	Cubic Feet per Min.	Velocity Ft. Per Min.	Area, Sq. In.
A	Immaterial	24,000	1,000	3456
B	"	21,000	900	3360
C	"	18,000	850	3048
D	"	15,000	800	2700
E	"	9,000	600	2160
F	"	9,000	600	2160
G	"	6,000	500	1728
H	"	3,000	400	1080
J	"	6,000	750	1152
K	"	1,500	400	540
L	"	4,500	600	1080
M	"	1,500	400	540
N	"	3,000	500	864
O	"	1,500	400	540
P	"	1,500	400	540
Q	"	1,500	400	540

Registers equal 1500/250 or 6 sq. ft. net. This method is short, simple and in practice gives good results, the areas being as shown in Fig. 2.

METHOD NO. 2.

Another engineer would not use a trunk line at all unless all the outlets were in the same room. Where different rooms are supplied with air, different temperature requirements are encountered and this is thought to be best taken care of by the individual duct system. In this system a single separate duct is carried to each room (in this case, each outlet) and the air is supplied at the warmer or cooler temperature required. Automatic control operates mixing dampers in the hot and cold air chambers so as to give the desired temperature.

This method is illustrated diagrammatically in Fig. 3, the velocity in the flues being 400 ft. per minute and in the ducts being 850 to 900 ft. per minute; the ducts are made 8 in. wide by the depth required to give this velocity.

1500/850 = 1.76 sq. ft. × 144 = 253.44 sq. in. and this divided by 8 = 31+ in. depth. 30 in. is usually adopted.

Velocity through registers 300 ft. per minute through free area. This gives a schedule of ducts and flues as shown in Table 2.

TABLE 2—DUCT AND FLUE SIZES AS FIGURED BY METHOD NO. 2.

Ducts and Flues	Length	Cu. Ft. Per Min.	Velocity Ft. Per Min.	Area, Sq. In.
All ducts....	Immaterial	1500	900	240
All flues....	Immaterial	1500	400	540

Registers 1500/30 equals 5 sq ft. net.

U. S. GOVERNMENT METHOD.

The United States Government uses a method based on using the same velocity throughout the ducts, with modifications, reducing the velocity beyond the center of distribution and increasing it before the center is reached. This method consists of reducing the size of the fan outlet to an equivalent number of 1-in. pipes and dividing this equivalent number of 1-in. pipes by the amount of air handled per minute; this gives a decimal by means

TABLE 3—CALCULATIONS ACCORDING TO U. S. GOVERNMENT METHODS

Cubic Feet per Min.	Distance, ft.	Add for Turns, ft.	Equivalent Distance, ft.	Cubic Feet Times Lineal Feet
Two of 1500 ea.	20	—	20	60,000
Two of 1500 ea.	40	—	40	120,000
Two of 1500 ea.	60	—	60	180,000
1500	100	—	100	150,000
1500	120	—	120	180,000
1500	140	—	140	210,000
1500	160	—	160	240,000
Two of 1500	100	50 (a)	150	450,000
Two of 1500	120	50 (a)	170	510,000
Two of 1500	140	50 (a)	190	570,000
				2,670,000

(a) Assumed at 30 in. diameter and 10 diameters for throat radius equal to 1D.

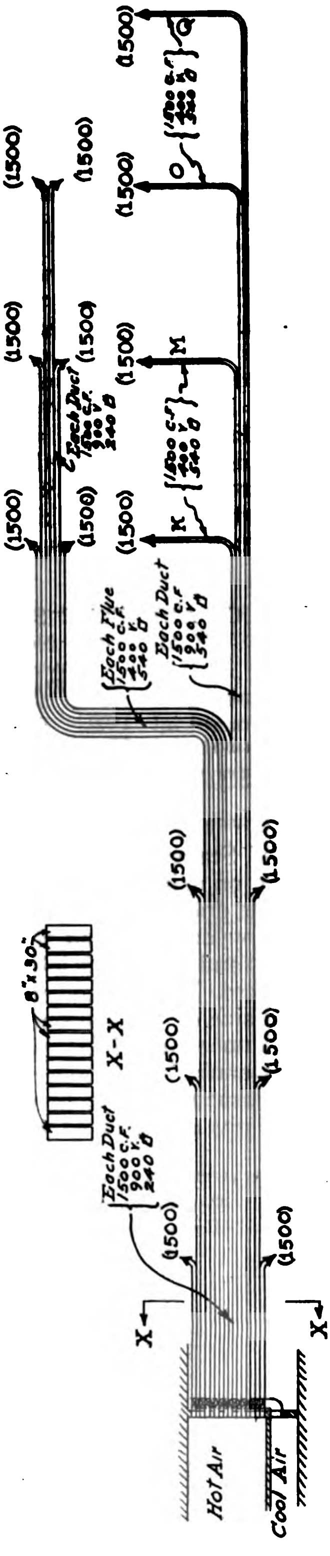

Hot Air
Cool Air
X
X
X-X
8"x30"
Each Duct 1500 C.F. 900 V. 240 □
Each Flue 1500 C.F. 400 V. 540 □
Each Duct 1500 C.F. 900 V. 540 □
Each Duct 1500 C.F. 900 V. 240 □
1500 C.F. 400 V. 540 □
1500 C.F. 400 V. 540 □
K
M
O
Q
(1500)

FIG. 3—SOLUTION OF PROBLEM ACCORDING TO METHOD NO. 2.

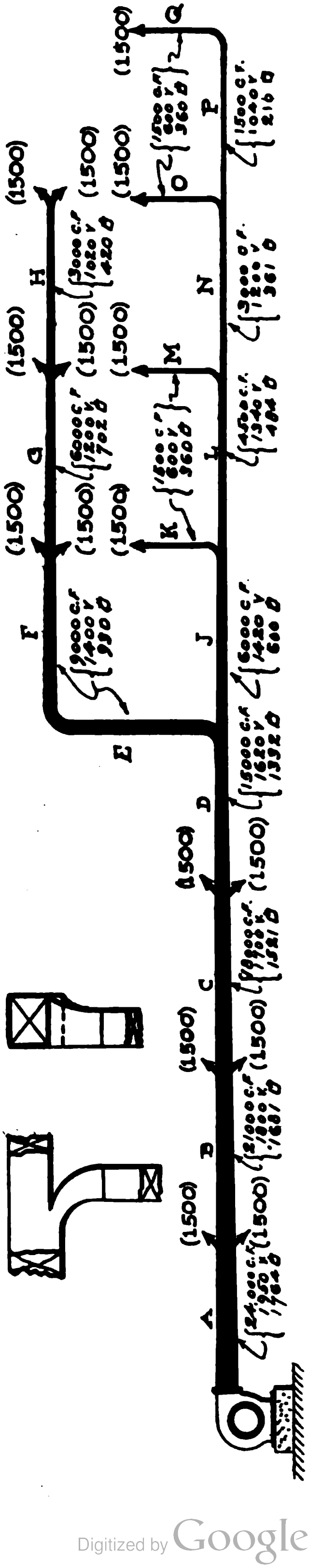


FIG. 4.—SOLUTION OF PROBLEM ACCORDING TO U. S. GOVERNMENT METHOD.

of which the area of any duct is obtained by multiplying the cubic feet of air per minute carried by this decimal. Then multiplying the cubic feet at each outlet by the distance back to the fan, adding the totals and dividing their sum by the total cubic feet of air per minute will give the number of feet to the center of distribution from the fan. One third of 1% is added for each foot beyond this center and 1/3 of 1% subtracted for each foot less than this center. The velocity in the vertical flues is 600, and 200 ft. per minute through gross area of register face.

Thus referring to Fig. 4 the outlets starting from the fan are as shown in Table 3.

2,670,000 ÷ 24,000 = 111 ft.

This is so near 110 ft. that 110 ft. may be taken for the sake of even figures. Then corrections on areas will be as shown in Table 4.

To get size of fan discharge and, therefore, the size of duct at the fan the size of fan must be first computed by the formula:

Cubic feet of air per minute $= AD^3N$.

$A = 0.42$ for air washer and ventilation fan.

C.F.M. = 24,000.

Tip speed of steel plate fan with air washer = 4,500.

$$\text{Therefore } \frac{4500}{\pi D} = N, \text{ or}$$

$$\frac{1430}{D} = N.$$

$$\text{C.F.M.} = 0.42\,D^3\,\frac{1430}{D} = 0.42\,D^2 \times 1430$$

$$= 600.60\,D^2 \text{ and } D^2 = \frac{\text{C.F.M.}}{600} \text{ or } \frac{24000}{600}$$

$40D^2$ and $D = \sqrt{40} = 6.3$, say 6-ft. wheel, or a 120-in. fan. A 6-ft. wheel at 4,500 ft. per min. tip velocity equals:

$6 \times 3.14 \times N = 4500.$

$18.84\,N = 4500.$

$N = 4500 \div 18.84 = 238$ R.P.M.

A 72-in. steel plate fan wheel has housing 57% of diameter of wheel, or 72 x 0.57 = 41.04 in., say, 42-in. housing and 42 in. x 42 in. outlet. Then the duct size at the fan will be 42 in. x 42 in., or equivalent to 11432 1-in. square pipes.

11432 ÷ 24000 = 0.476 factor.

In making branches the practice in this system is to make the branch the full height of the main, regardless of how narrow this makes the branch, put on the elbow, then transform into a circular or square duct as desired. This is illustrated in Fig. 4 by the detail of branch shown. The basis of computing the sizes of ducts and flues as shown in Fig. 4 is given in Fig. 5 and can be readily followed.

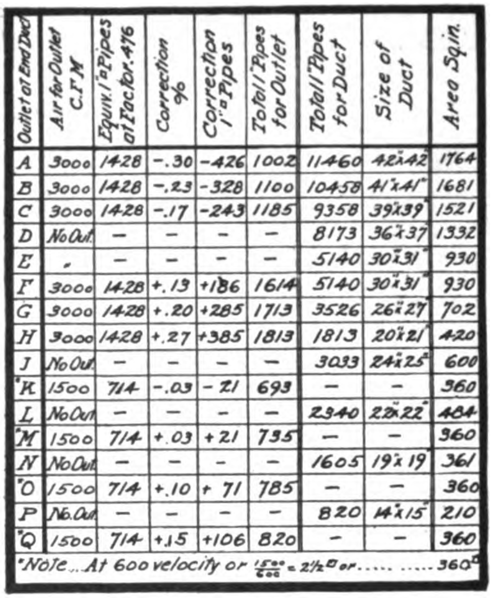
TABLE 4—CORRECTIONS ON AREAS.

Duct Supplying Outlet or Flue.	Center of Distribution, ft.	Outlet Distance, ft.	Feet.	Correction Factor.	Percentage.
A	110	20	—90	0.0033	—0.30
B	110	40	—70	0.0033	—0.23
C	110	60	—50	0.0033	—0.17
D	110	80	—30	0.0033	—0.10
EF	110	150 (a)	+40	0.0033	+0.13
G	110	170 (a)	+60	0.0033	+0.20
H	110	190 (a)	+80	0.0033	+0.27
J	110	100	—10	0.0033	—0.03
L	110	120	+10	0.0033	+0.03
N	110	140	+30	0.0033	+0.10
P	110	160	+50	0.0033	+0.16

(a) 50 ft. added as equivalent for two 90° bends.

METHOD USED BY NEW YORK DEPARTMENT OF EDUCATION.

In the New York schools still another method would be used. Here the outlets for any one section of a given floor are taken from a duct run horizontally on the ceiling of that floor, the duct being



Outlet at End Duct	Air for Outlet C.F.M.	Equiv. 1″□ Pipes at Factor .476	Correction %	Correction 1″□ Pipes	Total 1″□ Pipes for Outlet	Total 1″□ Pipes for Duct	Size of Duct	Area Sq.in.
A	3000	1428	−.30	−426	1002	11460	42″x42″	1764
B	3000	1428	−.23	−328	1100	10458	41″x41″	1681
C	3000	1428	−.17	−243	1185	9358	39″x39″	1521
D	No Out.	—	—	—	—	8173	36″x37″	1332
E	„	—	—	—	—	5140	30″x31″	930
F	3000	1428	+.13	+186	1614	5140	30″x31″	930
G	3000	1428	+.20	+285	1713	3526	26″x27″	702
H	3000	1428	+.27	+385	1813	1813	20″x21″	420
J	No Out.	—	—	—	—	3033	24″x25″	600
*K	1500	714	−.03	−21	693	—	—	360
L	No Out.	—	—	—	—	2340	22″x22″	484
*M	1500	714	+.03	+21	735	—	—	360
N	No Out.	—	—	—	—	1605	19″x19″	361
*O	1500	714	+.10	+71	785	—	—	360
P	No. Out.	—	—	—	—	820	14″x15″	210
*Q	1500	714	+.15	+106	820	—	—	360

*Note... At 600 velocity or $\frac{1500}{600}$ = 2½□ or .... 360□

FIG. 5—BASIS OF COMPUTING SIZES OF DUCTS AND FLUES ACCORDING TO U. .S. GOVERNMENT METHOD.

supplied from a main vertical flue, the bottom of which is kept as close to the supply fan as the exigencies will permit. Between the fan and the flues a velocity of 1,000 to 1,200 ft. per minute is maintained and in the flues a velocity depending on the height of the flue. The ducts running along the ceilings of the upper floors are arbitrarily graduated from 375 at the farther end up to 750 near the supply flue. In order to supply the 16 outlets under consideration the duct and flue system would be rearranged as shown in Fig. 6 so that each floor would be supplied from a horizontal duct located on the ceiling of that particular floor.

The schedule used for sizing the ceiling ducts is shown in Table 5.

The vertical flues are assumed at velocities as follows:—

VERTICAL FLUES.

Story	Velocity Ft. per Min.
5	1100
4	1050
3	1000
2	950
1	900

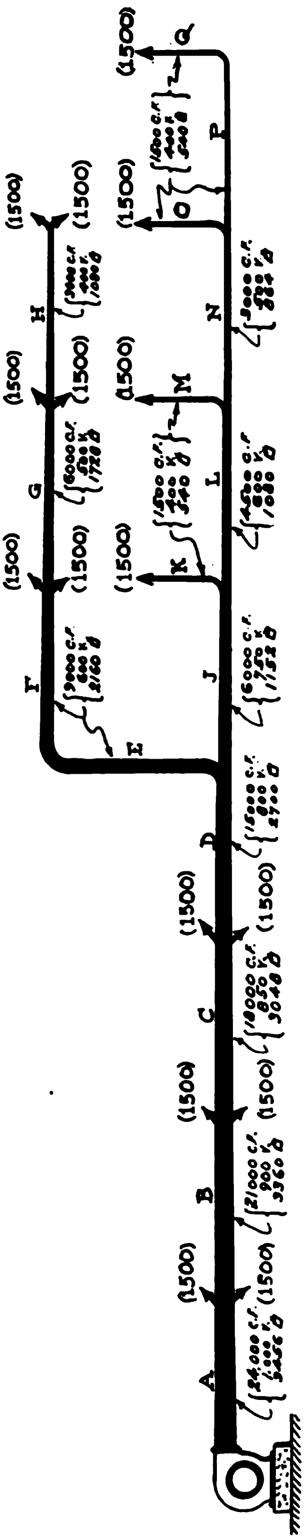


FIG. 6—SOLUTION OF PROBLEM ACCORDING TO METHOD OF NEW YORK CITY DEPARTMENT OF EDUCATION.

TABLE 5—SIZING CEILING DUCTS ACCORDING TO NEW YORK CITY DEPARTMENT OF EDUCATION METHOD.

Number of Rooms at 1,500 cu. ft. each.	Total Cubic Ft. per Min.	Horizontal Velocity Ft. per Min.	Area of Duct, Sq. In.
7½	11,250	750	2160
7	10,500	750	2016
6½	9,750	750	1872
6	9,000	750	1728
5½	8,250	750	1584
5	7,500	750	1440
4½	6,750	750	1296
4	6,000	750	1152
3½	5,250	750	1008
3	4,500	750	864
2½	3,750	700	771
2	3,000	650	664
1½	2,250	600	540
1	1,500	500	432
½	750	375	288

Registers at 250 ft. velocity over gross area.

This gives duct and flue sizes about as follows:—

TABLE 6—DUCT AND FLUE SIZES ACCORDING TO NEW YORK CITY DEPARTMENT OF EDUCATION METHOD.

Duct or Flue	Length	Cubic Ft. per Min.	Velocity Ft. per Min.	Area Sq. In.
X	Immaterial	24,000	1200	2880
Y	Immaterial	9,000	1100	1177
A	Immaterial	4,500	750	864
Aa	Immaterial	4,500	750	864
B	Immaterial	3,000	650	664
Ba	Immaterial	3,000	650	664
C	Immaterial	1,500	500	432
Ca	Immaterial	1,500	500	432
D	Immaterial	15,000	1100	1962
E	Immaterial	9,000	950	1463
Ea	Immaterial	6,000	900	960
F	Immaterial	4,500	750	864
Fa	Immaterial	4,500	750	864
G	Immaterial	3,000	650	664
Ga	Immaterial	3,000	650	664
H	Immaterial	1,500	500	432
Ha	Immaterial	1,500	500	432
J	Immaterial	6,000	750	1152
L	Immaterial	4,500	750	864
N	Immaterial	3,000	650	664
P	Immaterial	1,500	500	432

The registers are figured at 250 ft. per minute velocity over the gross area and as wire grilles are used this is practically 250 ft. per minute across the net area too. The reason for two ceiling ducts apparently paralleling each other is to prevent the open windows on one side the building blowing the air across the duct into the other side. In reality these two ducts consist of a single duct with a middle partition.

METHOD NO. 5.

A method used by another prominent engineer provides for temperature drop in the duct and then utilizes the equivalent number of 1-in. pipes in determining the duct areas. The amount of temperature drop is variable, depending upon the material used for the construction of the duct, its location, and its insulation. It is a very simple proposition to test the temperature drop for any length of run in an installation already working and to thus develop the number of feet of run for 1° drop in temperature. For convenience in calculating, it has been assumed in the following that there is 1° drop in every 20 ft. of run and the temperature at the fan is assumed as 120° F.; thus the air 20 ft. from fan would be 119° F., at 40 ft., 118°, etc.

The formula to obtain the quantity of air for any given B.T.U. loss per hour is:

Cubic feet per minute equals $\frac{\text{B.T.U.}}{60\ (\text{T-t})\ \text{DS}}$

When B.T.U. = heat required in B.T.U. per hour.

T = temperature Fahrenheit of entering air.

t = temperature Fahrenheit of room air.

D = density of entering air at temperature T.

S = specific heat of air.

60 = number of minutes in an hour.

If the heat loss in each room is exactly equal to the heat brought in by the 1500 cu. ft. of air at 120° F., and 70° F. is the room temperature, the heating requirement is

$$\frac{1500 \times (120 - 70) \times 60}{60} \text{ or } \frac{1500 \times 50 \times 60}{60}$$

$$= \frac{4500000}{60} = 75000 \text{ B.T.U.}$$

60 being the number of cubic feet 1 B.T.U. will raise 1° at 120° (temperature T).

Then, by substituting, the C.F.M. (for any outlet where the B.T.U. loss is 75000 B.T.U.) will equal:

$$\frac{75000}{60 \times (\text{T-t}) \times 0.0685 \times 0.2375}$$

At 1° drop in temperature every 20 ft. the temperature at the outlets at the end of duct will be:

A = 119° F = 114° K = 114½°
B = 118° G = 113° M = 113½°
C = 117° H = 112° O = 112½°
Q = 111½°

$$\text{A} = \frac{75000}{60 \times (119\text{-}70) \times 0.0685 \times 0.2375}$$

The fall in temperature is so slight in any one system that to save computation

$$\frac{75000}{60 \times 0.0685 \times 0.2375}$$

may be reduced to a constant, which divided by (T-t) will equal C.F.M. This reduces to

$$\frac{75000}{0.976125} \text{ or } 76940$$

$$\text{Then A} = \frac{76940}{119\text{-}70} \times 2, \text{ or } \frac{76940}{49} \times 2,$$

$$\text{or } 1570 \times 2 = 3140$$

$$\text{B} = \frac{76940}{118\text{-}70} \times 2, \text{ or } 1603 \times 2 = 3206$$

$$\text{C} = \frac{76940}{117\text{-}70} \text{ or } 1637 \times 2 = 3274$$

$$\text{F} = \frac{76940}{114\text{-}70} \times 2, \text{ or } 1748 \times 2 = 3496$$

$$\text{G} = \frac{76940}{113\text{-}70} \times 2, \text{ or } 1789 \times 2 = 3578$$

$$\text{H} = \frac{76940}{112\text{-}70} \times 2, \text{ or } 1832 \times 2 = 3664$$

$$\text{K} = \frac{76940}{114\tfrac{1}{2}\text{-}70} = 1729$$

$$\text{M} = \frac{76940}{113\tfrac{1}{2}\text{-}70} = 1769$$

$$\text{O} = \frac{76940}{112\tfrac{1}{2}\text{-}70} = 1810$$

$$\text{Q} = \frac{76940}{111\tfrac{1}{2}\text{-}70} = 1854$$

The total air to be delivered by the fan is the sum of these totals, or

A	3,140
B	3,206
C	3,274
F	3,496
G	3,578
H	3,664
K	1,729
M	1,769
O	1,810
Q	1,854
	27,520 C.F.M.

The same steel plate fan previously considered will deliver the required amount of air and, as previously noted, its outlet is 42 in. × 42 in. or equivalent to 11,432 1-in. pipes. Then the

$$\frac{11432}{27520} = 0.415,$$

say 0.42, the number of 1-in. square pipes to be allowed to each cubic foot of air per minute, this being called the factor (F). This factor, however, is usually made from 0.6 for shorter systems to 0.7 for longer systems to avoid excessive friction losses and high velocities. If 0.6 is used—

C.M.F.		F.		1-in. sq. pipes.
3140	×	0.6	=	1884
3206	×	0.6	=	1924
3274	×	0.6	=	1964
3496	×	0.6	=	2098
3578	×	0.6	=	2147
3664	×	0.6	=	2198
1729	×	0.6	=	1037
1769	×	0.6	=	1061
1810	×	0.6	=	1086
1854	×	0.6	=	1112

TABLE 7—DUCT SIZES, WITH ALLOWANCE FOR TEMPERATURE DROP, METHOD NO. 5.

H = 2198 or 21 in. × 22 in. = 462 sq. in. of duct
G = 2198 + 2147 = 4345, or 28 in. × 29 in. = 812 sq. in. of duct
E and F = 4345 + 2098 = 6443, or 33 in. × 34 in. = 1122 sq. in. of duct
P and Q = 1112, or 17 in. × 17 in. = 289 sq. in. of duct
O and N = 1112 + 1086 = 2198, or 21 in. × 22 in. = 462 sq. in. of duct
M and L = 2198 + 1061 = 3259, or 25 in. × 26 in. = 650 sq. in. of duct
K and J = 3259 + 1037 = 4296, or 28 in. × 28 in. = 784 sq. in. of duct
E and J = 4296 + 6443 = 10739, or 40 in. × 41 in. = 1640 sq. in. of duct
C = 10739 + 1964 = 12703, or 44 in. × 44 in. = 1936 sq. in. of duct
B = 12703 + 1924 = 14627, or 46 in. × 46 in. = 2116 sq. in. of duct
A = 14627 + 1884 = 16511, or 49 in. × 49 in. = 2401 sq. in. of duct

It can readily be seen that the proper quantity of air will be delivered to maintain the heat equilibrium and that the duct friction is kept at a fairly constant point, although not quite constant, as no allowance is made for bends, transformations, etc., and while the duct sizes thus obtained increase toward the far end of the system it is only because they are expected to handle a greater quantity of air at the same friction loss per foot of duct in order to compensate for temperature drop in the duct.

METHOD NO. 6.

Another engineering firm uses a velocity method in which the velocities at the end of the lines vary from a proportion of 30 per cent. to 60 per cent., according to the length of the duct system. The flues are designed for a constant velocity, but if flues are located near the fan, and space conditions demand, higher velocities are used. The highest allowable velocity of any flue near the fan depends upon the total pressure available for creating the flow of air. After the pressure available for the most unfavorable condition has been determined, the velocities are figured backwards and can thus be easily computed for any point desired.

Regardless of the exact velocities which may be used, any engineer can fix his own air flow speeds and the main point desired to bring out is that the ducts are sized on a *velocity* basis.

There are doubtless other methods of proportioning sizes, but it is felt that bringing these few important systems to the notice of the reader has opened up a profitable avenue of thought. The variety of paths, all of which lead to Rome, and lead *successfully,* makes it a question if the more laborious calculations (while perhaps more nearly theoretically correct) are not somewhat of a waste of time in practical work. Not one of the systems (no matter what formula it may be sized from) will give correct or even approximately correct results without the use of volume dampers, and, therefore, of what use is too much refinement? Is not the simplest, easiest and quickest way more economical in the engineer's time and equally satisfactory?

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IN PRESENTING this issue as a "Smokeless Boiler Number" a correspondent reminds us that, speaking technically, there is no such thing as a smokeless boiler. In other words, the boilers themselves have nothing to do with making smoke. At all times it is the furnace. For that reason the careful manufacturer, in his printed matter, simply refers to smokeless furnaces. In a typical catalogue, for instance, a boiler with smokeless furnace is shown facing the same type of boiler without smokeless furnace.

It is well to bear this distinction in mind, but, at the same time, it is highly desirable to have a short, but comprehensive, designation for boilers intended to be smoke-consuming, and until this is supplied, it is hard to think of a more easily understood term than "smokeless boiler."

◆

IT GOES without saying that the average householder, in the East, at any rate, knows little about the movement for smokeless combustion. He has always burned hard coal and has never had to give the matter any thought. This is true, almost to the same extent, in the case of heating contractors throughout the East. For that reason the general run of heating contractors has been more than shy in adopting the new types of heaters, and contractors have uniformly refused to guarantee them from the standpoint of smokeless operation.

We venture to state, however, that no unbiased reader can study the articles presented in this issue without realizing, first, that the smokeless combustion of coal is a logical and proper development in the heating industry and, second, that the increasing number of manufacturers who are adding "smokeless" boilers to their lines is proof in itself of the importance and success of the movement. In short, it is obvious that the "smokeless" boiler has come to stay, and we feel that we are doing a very real service in awakening the general trade to the situation that confronts it in this connection, as well as to its opportunities in promoting this comparatively new and important phase of the heating art.

◆

OCTOBER sees a renewal of the activities of the engineering societies and, in the case of the heating engineers, the existence of local organizations (some of them newly formed), with headquarters in New York, Boston, Philadelphia, Cleveland, Detroit and Chicago, promises a season of more than usual interest. Between the compilation of codes of ethics, the work of educational committees and co-operation with ventilation commissions, there is a call to everyone connected with the profession in the localities named to get together and accomplish some constructive work this year. In the language of the day, "this means you."

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

65—The Economy of Superheated Steam.

QUESTION: What is the difference between saturated steam and superheated steam, and why is the latter more economical for power?

ANSWER: The difference is purely one of physical condition. Every steam pressure has a corresponding fixed temperature in the case of saturated steam and this condition obtains, when the steam and water are in contact in the same vessel or reservoir.

Before water becomes steam, the latent heat has to be added, amounting to a varying quantity from 762 B. T. U. per pound of steam, at 500 lbs. pressure, to 1034.6 B. T. U. per pound at 1 lb. pressure absolute. This latent heat has to be provided for each pound of steam used for power, although it cannot be utilized. This explains the reason for the economy in the use of exhaust steam for heating.

Since the sensible heat or visible temperature of steam increases with the pressure and the latent heat decreases, the total heat supplied, to produce any pressure and temperature, is nearly the same per pound, or there is a variation of only 1200 B. T. U. per pound at 500 lbs. pressure to 1100 B. T. U. per pound at 1 lb. pressure absolute.

Therefore, raising the initial pressure on a boiler does not increase the fuel expense appreciably, except for the losses in radiation due to the higher temperatures. Superheated steam is a condition obtained by adding heat to the steam when not in contact with the liquid, and the temperature raise is approximately 2 degrees for each B. T. U. added per pound of gas.

The use of superheated steam is more economical, but the impression is frequently conveyed that the economy is due largely to the peculiar features of the particular type of engine or turbine under consideration. This may be true to a slight extent, but the economy, as will be shown, is mainly due to the condition of the steam. That is, if superheated steam were used on any engine at the same pressure as saturated steam, regardless of the type, some saving would be shown, although this would be increased somewhat if the engine were especially adapted for the use of superheated steam.

The statement has often been made that the only advantage in the use of superheated steam, when used on a reciprocating engine, is in the reduction of cylinder condensation due to radiation of the heat and the reheating of the cylinder walls with the varying pressures and temperatures, as the steam is expanded in doing work. This is also true, to a certain extent, as when heat is lost by radiation from the cylinder walls in the case of saturated steam, a certain percentage of water is formed, reducing the volume of gas at the rate of approximately 400 units of volume for each unit of volume of water produced, say, at 50 lbs. pressure.

In the case of superheated steam, there is no water produced and the volume only changes slightly for the loss of heat, no water being formed. Of course, the above assumes working conditions as would be obtained in practice.

If sufficient heat were extracted, the superheat would be lost, and if further radiation occurs, water would be produced the same as if the steam were saturated, only not to the same extent.

For each unit of weight condensed, the latent heat at approximately 1000 B. T. U. per pound, has to be radiated, so the quantity of water would be comparatively small in most cases and could easily be eliminated entirely by the use of superheated steam. When water is once formed, it takes the same amount of heat to re-evaporate it, and as the specific heat of steam is approximately one-half that of water, the presence of the latter in the cylinder causes uneconomical operation. In the generation of steam, the big item is the latent heat which is about seven times the actual heat capable of being utilized for power, before it is exhausted to the atmosphere or condenser.

The minimum weight of fluid or water used to produce steam at any pressure will prove more economical as requiring less latent heat. If we assume a pressure of

190 lbs. absolute, of which we require a certain number of cubic feet per unit of time, the difference in heat to produce a cubic foot of steam at saturation and at 200 degrees super-heat will be as follows:

190 lbs. pressure, absolute—	T'l heat above 32 deg. F, B. T. U.	Temperature, Deg. F.	Cu. ft. per lb.
Saturated steam...	1197.3	377.6	2.41
Superheated steam, 200° F...........	1306.3	577.6	3.19

The total heat includes that required to raise the water from 32° F. to 377°, and the latent heat at 190 lbs., or 846.9 B. T. U. per pound.

We will assume the water taken at an initial temperature of 210°, as this feed water temperature is generally obtained from waste gases or exhaust steam, and determine the quantity of heat required to produce a cubic foot of steam under each condition named, as one will operate as well as the other to produce power after steam is generated.

The heat required to raise the feed water from 32° to 212° will be 180 B. T. U. per pound, and the heat required per pound for each condition will be as follows:

Saturated steam: 1197.3 — 180 = 1017.3, B. T. U. per pound.

Superheated steam: 1306.3 — 180 = 1126.3 B. T. U. per pound.

In the first case, if we obtain 2.41 cu. ft. from each pound of liquid, we have the heat per cu. ft. to be supplied.

1017.3 ÷ 2.41 = 422.1 B. T. U. per cu. ft.

In the second case we obtain 3.19 cu. ft. from each pound.

1126.3 ÷ 3.19 = 353.1 B. T. U. as the heat required to produce, at 190 lbs. pressure, 1 cu. ft.

This would show a saving in steam generated of:

422.1 ÷ 353.1 = 1.196, or a saving of almost 20% in the use of superheated steam before it enters the engine. There are also the advantages of overcoming the radiation of machinery parts and piping, without obtaining water due to condensation.

It is readily seen that the economy is due to the increase in the volume due to superheating and to the fact that the latent heat is a constant quantity and a large proportion of the total amount in both cases. The economy is really independent of the type of engine, although, as stated, some types are better adapted to its use than others.

The expense of installation and up-keep, however, is very great when superheated steam at high temperature is used, as the piping fittings and valves have to be made of special steel as well as the engine and its valves.

The foregoing is not especially a plea for the use of superheated steam, but merely to show that the economy lies in the physical characteristics of the steam, rather than in the type of engine.

LEGAL DECISIONS

Discriminative Taxation of Heating Co.

When there are two or more public service corporations engaged in furnishing heat, light and power to the people of a city and occupying the streets, alleys and public places of the city with their apparatus for that purpose under franchise granted by the city, the fact that one furnishes heat, light and power by electric current conveyed by wires and the other by gas conveyed by underground mains does not furnish a sufficient basis for classification to justify an occupation tax upon one of the companies and not upon the other. A tax so levied is void for unjust discrimination.—City of Lincoln vs, Lincoln Gas & Electric Co., Nebraska Supreme Court, 158 N. W. 962.

Heating Radiation as "Fixtures."

The Michigan Supreme Court holds that heating radiation upon several floors of a five-story business building, which had been installed by a tenant and was capable of removal from the premises, was not part of the realty which would pass by the landlord's lease, but constituent fixtures belonging to the former tenant. The term "fixtures" in connection with such a building means such chattels as merchants usually possess and annex to the premises occupied by them, to enable them the better to store, handle and display their goods and wares. They are generally removed without material injury to the premises.—Lovett vs. Birmingham-Seaman-Patrick Co., 158 N. W. 883.

Damages for Owner's Breach of Installation Contract.

Action was brought for damages for breach of contract whereby the defendant engaged the plaintiff to install a heat and water plant in the defendant's residence. The plaintiff shipped the necessary materials and supplies to the railway station nearest the defendant's residence, but the defendant refused to permit the plant to be installed, alleging the contract had been procured by fraud. The plaintiff installed the plant for another at a sum much less than that the defendant agreed to pay him, and claimed the difference as damages. He offered no proof of the value to him of the contract with the defendant, had it been fulfilled. On appeal from a judgment for the plaintiff, the North Dakota Supreme Court held that the plaintiff was entitled to the benefit of his bargain, nothing more, and in order to recover he must establish what, if anything, such bargain was worth to him. It was therefore incumbent upon him to prove what sum the labor and materials necessary for the installation of the plant would reasonably cost him at or about the time the plant was to be installed, and his damage would be the excess, if any, of the contract price above such sum.—Turner vs. Affedt, 158 N. W. 263.

Time for Filing Mechanic's Lien.

In an action to foreclose a mechanic's lien for a balance due for installing a heating plant in the defendant's residence, it appeared that the plaintiff, with the consent of the defendant, removed part of the boiler and replaced it because the plant was unsatisfactory. The Indiana Appellate Court held that the removal and repair would be deemed the lost work done by the contractor, and notice of lien filed within 60 days thereafter would entitle him to a lien.

Heating and Ventilating Employee Sues General Contractors.

In an action for damages for personal injuries by an employee of heating and ventilating contractors against general contractors, it appeared that the defendants had a contract with a school board to erect a school building complete save a heating and ventilating system. The company for whom the plaintiff was working had a contract with the school board for installing that system. The defendants and the plaintiff's employers were each at the same time carrying out their respective contracts with the school board. The defendants, under their contract, were to furnish and install joists in the attic of the building, upon which a tank that was to be a part of the heating and ventilating system was to be placed by the plaintiff. The defendants knew that this was one of the purposes for which the joists were to be used. After the defendants had selected and installed the said joists, but before they had fully completed their contract and turned the building over to the school board, the plaintiff in installing the tank went upon the joists, one of which broke, as a result of which he fell and was injured. The Oklahoma Supreme Court holds that if the defendants knew, or by the exercise of ordinary care could have known, that the plaintiff might be reasonably expected to go upon the joists in installing the tank, the defendants owed the plaintiff the duty to exercise ordinary care in the selection of the joists, although the relation of master and servant did not exist. Judgment for the plaintiff was affirmed.—Lisle vs. Anderson, 159 Pac. 278.

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Is Washed Recirculated Air Better Than Fresh Air?

A note published in last month's issue referred to the recent tests with washed and partly recirculated air, and with fresh outdoor air, in one of the Bronx, New York, schools and quotations were given from the report on the tests, signed by E. L. Thorndike, G. J. Ruger, and W. A. McCall. According to this report, as good progress was made by children subjected to partly recirculated air as by those provided with a liberal supply of outside air. The rate of improvement recorded by both groups was decisive, but the advantage was found to be with the children supplied with washed, recirculated air. The tests given the children did not include health tests, but had to do with progress in their studies and other tasks.

In discussing this report a correspondent has called attention to the danger of their being misinterpreted by those who do not thoroughly understand the details of the test.

"Very serious and irreparable harm is likely to result," he states, "from such reports if school authorities are led thereby to install purely recirculating systems of ventilation, as they are almost always certain to prove injurious to health. As a matter of fact the tests so far made by the New York State Commission on Ventilation have been so unsatisfactory, and so lacking in conclusive evidence that the commission has until now refrained from promulgating any official statement of its findings.

"The reason for this is that the only 'indicators' available for use in such tests are so delicate that the errors of observation are almost as great as the observable variations due to test conditions, especially as the human body accommodates itself remarkably well to ordinary variations in climatic conditions, and also because the effects of conditions under which the pupils live at home and elsewhere, outside of school hours, are quite as liable to affect the test findings, as are the conditions under which the tests are being made.

"Moreover, in the tests in question, the pupils, it should be remembered, were not subjected continuously to recirculated room air with no admixture of fresh air. From the percentage of CO_2 noted in these tests, it is evident that the so-called recirculated air in the tests referred to was very largely fresh air entering the room through window and wall leakages, etc. Not attempt was made, apparently, to prevent the usual and very considerable infiltration of air.

"Another point in connection with these tests is that the problem was treated from one side only, that of increase in learning, totally ignoring the possible dangers to health involved.

"Even if recirculated air is washed, it is very doubtful if all disease germs are eliminated thereby, and in the absence of exact knowledge as to what transmits such diseases as infantile paralysis, it surely behooves heating engineers and sanitarians to avoid all possible causes of the spread of this disease.

"Moreover, it is absolutely unsafe to trust to janitors to exercise discretion as to the proper amount of fresh air which should be added to the recirculated air, or to see that such proper admixture is always obtained.

"There are, of course, many eminent authorities who are willing to claim that air cannot spread diseases, but it is better to be safe than sorry, and the saving in coal to be effected by the partial use of recirculated air, in the writer's judgment, should not be considered in view of the doubt as to the dangers to health possibly caused thereby."

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Current Heating and Ventilating Literature.

(Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from The Heating and Ventilating Magazine *on receipt of the stated price.)*

CENTRAL STATIONS—

Central-Station Heating Plant Operation in Milwaukee. O. M. Rau. Ils. 2500 w. El W—July 29, 1916. Electrical energy produced as by-product of heating plant. 20c.

Central Station Steam Heating by Miles City, Montana, Municipal Plant. G. C. Pruett. 3000 w. Mun E—July, 1916. Successful plant. 40c.

HEAT TRANSMISSION—

Effect of Velocity and Humidity of Air on Heat Transmission Through Building Materials. J. A. Moyer, with discussion. (Abstract.) 8 pp. A S R E—July, 1916. Discussion of tests made at Penn State College. 60c.

HOT-WATER SYSTEMS—

Hot Water Heating Systems. William Schultheis. 1000 w. N E—July, 1916. Tables and calculations. 20c.

POWDERED COAL—

Powdered Coal Burning. Ills. 800 w. I A—July 20, 1916. Plant at Middletown, Pa. 40c.

STEAM TRAPS—

Kinds and Uses of Steam Traps. Ills. 2000 w. Pwr—July 11, 1916. Characteristics of various classes. 20c.

CORRESPONDENCE

Data on the Capacity of Heated Air to Carry Moisture.

Editor Heating and Ventilating Magazine:

Referring to the correspondence published in your August and September issues regarding the capacity of heated air to carry moisture, it does not seem to the writer that you have proved your point or succeeded in controverting the statement made by Kent. The writer of your reply is evidently biased towards blowers for drying purposes.

Our company has had a wide experience with all kinds of drying equipment, and in connection with our observation of blowers, we have found that they invariably fail to get proper humidity for efficient drying. We are vitally interested in this subject because the question is coming up every day in the operation of drying equipment.

It would seem to us rather strange if there is not some recognition in standard text-books or hand-books of the fact that high humidities, in rapidly-moving blast systems of drying, are difficult, if not impossible to maintain.

In further reply to our correspondent we take pleasure in presenting herewith the following discussion of the subject contributed, on request, by Professor William Kent:

"Referring to the correspondence on

'Capacity of Fans to Carry Saturated Air,' on page 51 of your August issue, and to the statement quoted from my 'Mechanical Engineers' Pocketbook' that 'as a carrier of moisture hot air cannot in practice be charged half its full saturation, and it is in fact considered a satisfactory result if even this proportion be attained,' this statement is quoted from Mr. Emil Passburg's paper in Prac. Inst. Mech. Eng. for 1889, and Mr. Passburg is good authority. As far as I know, the statement is strictly correct, if emphasis is put on the words 'in practice.' No doubt, theoretically, nearly complete saturation might be obtained if the apparatus were run slowly enough to give the air plenty of time to become saturated before leaving, and if it could be insured that there would be no short-circuiting or stratification of the air in its passage through the material, and if the temperature of the air admitted were high enough to cause it to carry in enough heat to effect the evaporation of the water.

"In the later editions of my Pocketbook, I have given much more matter on the subject of drying, but nothing in contradiction of Mr. Passburg's statement.

"Consider an ideal case of a sand dryer, a vertical clyinder 1 ft. in diameter, with a hopper at the top to receive the wet sand, open at the bottom to allow the sand to flow into a box beneath, and in the cylinder a screw conveyor slowly revolving to keep the sand from clogging or scaffolding as it flows downward. Hot air is blown in through a ring of holes near the bottom. Assume that the hopper receives 100 lbs. of sand per minute (weighed in the dry state), and 20 lbs. of water. Suppose that the air has been dried by passing it through a refrigerator, and is then heated to 200° F. before passing into the bottom of the dryer. 1 lb. of air heated to 200° F. has a capacity of absorbing 2.3 lbs. of water, but as it cools in traveling upward through the moist material we are not concerned with its total capacity when at its hottest, but only with

TABLE SHOWING RELATIONS OF TEMPERATURE AND AMOUNT OF AIR REQUIRED FOR DRYING.

Temperature of entering air and of dry sand, deg. F.	200			300	
Temperature of escaping air and moisture, deg. F.	80	100	120	100	120
Total heat above 60° F. of 1 lb. escaping air, B. T. U.	4.8	9.6	14.4	9.6	14.4
Total heat above 60° F. of 1 lb. escaping moisture, B. T. U.	1,067	1,076	1,085	1,076	1,085
Total heat above 60° F. of 100 lbs. dry sand, B. T. U.	2,800	2,800	2,800	4,800	4,800
B. T. U. for evaporating 20 lbs. water	21,340	21,520	21,700	21,520	21,700
B. T. U. for evaporating water and heating sand	24,140	24,320	24,500	26,320	26,500
B. T. U. in 1 lb. entering air, less B. T. U. in escaping air	28.8	24.0	19.2	48	43.2
Pounds air required to furnish total heat	838	1,013	1,276	548	613
Pounds moisture in 1 lb. escaping air, saturated	0.02226	0.04305	0.0813	0.04305	0.0813
Pounds saturated air carrying 20 lbs. water	898	465	246	465	246
B. T. U. in this air for evaporating water and heating sand	25,863	11,160	4,723	22,320	10,617
Excess B. T. U. over that required	1,723	......	......	......	......
Deficiency in B. T. U. over that required	......	13,160	19,777	4,000	15,883
Relative humidity in escaping air, per cent.	100	45.9	19.3	84.9	40.1

the capacity when it escapes from the cylinder.

"Suppose it escapes at 100° F. Then each pound of air will carry, when fully saturated, only 0.043 lbs. of moisture, or, if 50 per cent. saturated, only 0.0215 lbs. In order to carry away the 20 lbs. of water from the 100 lbs. of sand per minute, the amount of air required per minute, if fully saturated when it leaves, would be 20 ÷ 0.043 = 465 lbs., or at 13 cu. ft. per pound (measured at 50° F.), 6045 cu. ft. If the air on leaving were only half saturated, twice this amount would be required.

"Now how much air would actually be required in practice? A calculation on the heat unit basis may furnish at least an approximate answer. If the wet sand is introduced at 60° F., and the moisture leaves at 100° F., each pound of moisture must have supplied to it (100 — 60) + latent heat 1036 = 1076 B. T. U., or 21,520 B. T. U. for the 20 lbs. of water in the sand. If the sand left the dryer at 200° F., it would carry away (above 60°) 100 × (200 — 60) × specific heat 0.20 = 2800 B. T. U.

"Each pound of air at 200° carries in (200 — 60) × specific heat 0.24 = 33.6 B. T. U. (measured above 60° F.), and takes away, at 100° (100 — 60) × 0.24 = 9.6 B. T. U., leaving 24 B. T. U. available per pound of air for evaporating the water in the sand. Dividing 21,520 + 2800 by 24 gives 1,013 lbs. as the amount of air needed for evaporating the water and heating the sand. As only 465 lbs. of air would be required if the air were saturated, the degree of saturation of the 1,013 lbs., when escaping, would be 465 ÷ 10.13, or 45.9 per cent.

"This calculation takes no account of loss of heat by radiation or other possible losses.

"I have made five calculations whose results appear in the accompanying table, which show that the degree of saturation of the escaping air depends on the temperature both of the escaping and entering air, and that the amount of air required for drying depends also on both of these temperatures."

FURTHER DISCUSSION BY F. R. STILL.

There seems to be a misunderstanding between your correspondent, Professor Kent, and the writer in this discussion which appears to be due to the fact that there has not been submitted a concrete example on which to work. The hypothetical case submitted by Professor Kent does not seem to the writer to conform to the problem as it was originally stated.

If your correspondent will present a case covering his question in detail wherein all the points, which vary in every dryer problem, are clearly and definitely set forth, so that calculations can be made better than in the abstract, then very likely correct and definite replies could be given.

The writer sees no reason for changing his conclusions as previously expressed in your columns because of the further statements made by your correspondent or the problem submitted by Professor Kent, as the two harmonize.

Reviewing again the writer's statements in your last issue, one cubic foot of air at 50° F. outside temperature, and which is 50 per cent. saturated (this being average temperature and humidity conditions througout the year) will carry 2.12 grains of moisture. Heating this 1 cu. ft. of air to 200° will increase its volume to approximately 1.293 cu. ft., but it still contains only the same 2.12 grains of moisture it had originally.

Now if this air at 200° temperature comes in contact with a wet substance, which latter is properly arranged inside of a chamber for that purpose, and the moisture can be readily evaporated from the substance when so arranged, and the air is circulated at just the right velocity so that it is finally reduced to the lowest possible temperature without precipitation before it escapes from the compartment wherein the drying operation is taking place, the air could only be lowered to 84° when it would become completely saturated, and anything below this temperature would cause precipitation. It will then carry about 12.3 grains of moisture or it has absorbed 10.18 grains in addition to what it originally carried.

Now again, if this air were allowed to escape at 100°, it would only carry 10.7 grains, or it will have absorbed about 8.52 grains, which is only about 84 per cent. of the amount it would have absorbed if allowed more time so that it could be cooled down to 84°, and it would be about 54 per cent. saturated instead of 100 per cent. as before.

Again suppose the air were allowed to escape at 120°, it would only carry about 8½ grains or it will have absorbed 6.32 grains, which is about 62 per cent. of the amount absorbed in the first instance, and would only be about 24½ per cent. saturated.

All the foregoing presupposes that there are no losses by heat radiation from the dryer; no air leakages, nor any heat required by the material to raise it to and maintain it at the temperature required to

do the drying. As none of these things exist in actual practice, it is either necessary to make up the loss by applying heat in some other way than by the heat obtained in the air or by increasing the volume of the air so as to have enough heat to take care of the losses to raise the air from its initial temperature, and to do the evaporating. This latter is what is usually done, as stated by the writer in last month's issue, and this usually results in the air being finally about 20 to 30 per cent. satuarated when it escapes from the dryer in actual practice.

Referring now to Prof. Kent's problem, all his figures go to prove our contention that air can be saturated to 100 per cent. when it is circulated by a blower. All that is necessary is to give it time enough to absorb all the moisture it can carry, whereby it will be cooled down, and thus become saturated. In average practice, however, this has the effect of slowing up the drying process beyond a point where it is efficient, and, besides this, in the drying of many substances, fermentation, discoloration, and other physical defects will appear which are permanently injurious to the substance if the temperature is allowed to get too low, and the air becomes too highly saturated at a low temperature. This statement is quite readily proven by Prof. Kent's tabulation. Referring to the 220° entering temperature, and 80° temperature of escaping air; his calculations would show that the air becomes saturated long before the temperature is reduced to 80°. Again, referring to the 300° entering temperature, and 100° outlet temperature; in this case the relative humidity of the escaping air is nearly 85 per cent. If the temperature were reduced down to about 95° this would show very close to complete saturation.

Prof. Kent's problem of 100 lbs. of sand and 20 lbs. of water might be used as an example by making certain modifications and employing some arbitary constants to fill in so that it would practically cover a real drying problem.

We have never come in contact with any substance which has to be dried *absolutely* dry; in fact, there is no use doing it because any substance so dried will immediately take up from 4% to 6% moisture on the average from the atmosphere as soon as it regains its normal temperature after leaving the dryer. We, therefore, will consider in this case 100 lbs. of sand, 19 lbs. of water to be evaporated; one pound of water retained in the sand after it leaves the dryer, and have figured on 15 lbs. weight of the mechanical equipment necessary to convey the sand through the drying apparatus and have allowed 35% for leaks from the drying plant and covering the heat necessary to take care of the losses by radiation from the walls, roof, floor, ducts, etc., of the dryer building.

Let us first consider raising the temperature from 60° F. to 200°, and that after the air has passed through the dryer, it leaves at a temperature of 100°. We will also take the specific heat of sand as 0.20; the latent heat of evaporation at 100° as 1,036 B. T. U. and the specific heat of the mechanical equipment of 0.13. We will have to raise the temperature of the sand from 60° to 200° and as there is 100 lbs. of this to heat, it will amount to 2,800 B. T. U.. We will have 19 lbs. of water to evaporate, which will be raised from 60° to 100°. This will make 760 B. T. U. There is one pound of water retained in the sand which will be raised from 60° to 200°, which will make 140 B. T. U. The latent heat of evaporation for 19 lbs. of water will amount to 19,684 B. T. U. Fifteen pounds of mechanical equipment raised from 60° to 200° will amount to 273 B. T. U. The sum of this is 23,657 B. T. U., and adding 35% will amount to about 8,343, which added to the above will make a total of 32,000 B. T. U. required for the dryer.

The heat given up by the air in the process of evaporation will amount to 200° minus 100° times 0.2375, which equals 23.75 B. T. U. per pound of air. As the dryer and the process will require 32,000 B. T. U., this divided by 23.75 equals 1,347 lbs. of air.

One pound of air at 100° completely saturated will carry 0.0428 lbs. of water. If the entering air at 60° is 50% saturated, then the air will contain 0.00545 lbs., which subtracted from the amount in the air when totally saturated, will leave 0.03735 lbs.

As we have to evaporate 19 lbs. of water, then dividing this by the amount of moisture one pound of air can take up before becoming completely saturated, will give us 509 lbs., and if we divide this latter by 1,347 lbs., which is necessary to furnish the heat and do the drying, we find that the air as it leaves the dryer will be 37.8% saturated.

The heat necessary to raise one pound of air from 60° to 200° will be 33.25 B. T. U. and this multiplied by 1,347 lbs., gives us 41,500 B. T. U., which is the total heat put into the air as admitted to the dryer. Dividing the total heat required by the dryer by the total heat put into the air, gives us 77.2% as the relative heat required by the drying process as compared with the total heat put into the air.

Now if we work out this problem along the same lines as outlined above, raising the air from 60° to 200° and allow the air to escape from the dryer at a temperature of 120°, the drying process will require 32,200 B. T. U. and it will require 1,695 lbs. of air to furnish the heat. We will only require 251 lbs. of air when completely saturated, which will give us a relative saturation when the air leaves the dryer of only 14.8% and the relative heat required for drying as compared with the total heat put into the air will be 57.2.

Carrying this on again, figured on raising the air from 60° to 200° and have the air leave the dryer at 88°, then the total heat required for the dryer would amount to 27,800 B. T. U. It would only require 836 lbs. of air to furnish the heat and it would take 818 lbs. of air completely saturated, which would give a *relative saturation of* 98% as the air leaves the dryer and the relative heat for drying to the total heat required for heating the air would amount to 100%. This latter shows that if the temperature is lowered down far enough and one disregards the length of time it will take to do the drying when such a low temperature is attained, then it is possible to have *the air leave the dryer completely saturated.*

One other example, showing a comparison of the results with a higher temperature in the dryer, but leaving at the same temperature as was given in the first case, will show that this has the effect of more than doubling up the relative saturation. For instance, if the air is heated from 60° to 300°, and leaves the dryer at 100°, the total heat required for drying would amount to 34,900 B. T. U. and it would only require 612 lbs. of air to furnish the heat and would require only 509 lbs. of air the same as in the first case to complete saturation. Hence, the relative humidity would be 83.2%. The total heat put into the air would be 47,600 B. T. U., thus the relative heat for drying to the total heat required for the air would be 73.3%, which is a lower ratio than in the first case.

The fine points of the art of drying do not lie so much in the ability of an engineer to determine the amount of heat required, nor the relative saturation of the air as it leaves the dryer, although it is necessary, of course, for him to have this ability. It does rest more on his experience with different products in knowing what is the critical temperature they will stand without injury; also what is the maximum amount of saturation that can be permitted within the dryer without causing any objectionable chemical reaction that will lead to fermentation, discoloration or other injury, as well as to obtain the best possible commercial balance in the speed with which the product can be dried at the least possible operating expense and initial investment.

How to Figure Economy or Cooling Coils.

As used in central station heating practice, economy coils are a necessary auxiliary to adapt existing piping in buildings to an outside steam supply. Data for figuring the sizes required for given conditions and the savings effected were presented by Walter J. Kline at the recent annual convention of the National District Heating Association. Mr. Kline described an economy coil as an indirect hot water radiator, arranged so that all condensate from the individual heating system must pass through it. Furthermore, it must be suitably enclosed and have controlled air inlet and outlet ducts. The necessity for their use arises from the fact that the condensate leaves the radiators at approximately 212° F. and unless a proper means is devised for utilizing a considerable portion of this remaining heat, the result is a continuous loss. The principal use for economy coils is in connection with those heating systems where the condensation is more than the minimum allowable, or in most cases up to about 212°.

FIGURING THE REQUIRED SURFACE RATIO.

A pound of steam at 0 lbs. has the following properties: Temperature, 212° F.; latent heat, 970.4 B.T.U.; sensible heat, or heat in the water or condensate, 180 B.T.U.

It is obvious that the exact ratio will be found, if we separately calculate the radiating surface necessary to transmit the latent heat and then calculate the economy coil surface necessary to conserve or extract the sensible heat in the condensate. If we assume an inside temperature of 70° and use a co-efficient of transmission of 1.8 B.T.U. per hour per degree difference per square foot of direct cast-iron radiation, we have $212 - 70 = 142°$, and the total B.T.U. per square foot of direct steam radiating surface per hour is $1.8 \times 142 = 255.6$ B.T.U. $970.4 \div 255.6 = 3.7965$ sq. ft. of surface required to radiate the latent heat in 1 lb. of steam in one hour.

In determining the relative amount of economy coils, certain assumptions must be made. Assuming a room temperature of 70°, and an outside air supply of zero, heated to 70°, the limit of effective cooling of condensation will be the room temperature, 70°. While this is not practically attainable, it will serve as a basis of calculation.

Then $70 \div 2 = 35°$, average temperature air supply. $212 - 70 = 142°$ total temperature reduction.

$$212 - \frac{212 - 70}{2} = 141°,$$ average temperature of condensation.

$141 - 35 = 106°$, average difference in

SAVINGS EFFECTED BY COOLING COILS AT VARIOUS DEGREES OF COOLING.

(A) Temperature trap discharge, deg. F....	212	212	212	212	212	212	212	212	212	212
(B) Temperature economy coil discharge, deg. F..............	212	150	140	130	120	110	100	90	80	70
(C) B. T. U. saved per pound	0	62	72	82	92	102	112	122	132	142
(D) B. T. U. utilized per pound, 970.4 + C...	970.4	1032.4	1042.4	1052.4	1062.4	1072.4	1082.4	1092.4	1102.4	1112.4
(E) Per cent. saved of total required C ÷ 970.4	0	6.37	7.41	8.45	9.48	10.51	11.54	12.57	13.60	14.60
(F) Pounds steam required per sq. ft. (970.4 x 500) ÷ D..	500	470	465	461	456	452	448	444	440	436
(G) Pounds steam saved per sq. ft. radiation.	0	30	35	39	44	48	52	56	60	64
(H) Total pounds saved by 1 sq. ft. coil, G x 5..............	0	150	175	195	220	240	260	280	300	320
(J) Value at $0.50 per 1000 lbs.	$0	0.075	0.0875	0.0975	0.11	0.12	0.13	0.14	0.15	0.16
(K) Per cent. profit on investment in coils..	0	15	17.5	19.5	22	24	26	28	30	32

temperature. 1.8 B.T.U. (Carpenter) x 106 = 190.8 B.T.U. transmission per square foot of coil surface per hour.

Therefore, 142 ÷ 190.8 = 0.744 sq. ft. of economy coil surface required to radiate the sensible heat available hourly in the condensate of 1 lb. of steam.

Having now determined the necessary coil surface (0.744 sq. ft.) and the necessary steam radiation surface (3.7965 sq. ft.) we find the ratio to be 0.744 ÷ 3.7965 = 19.60%, or practically 1 sq. ft. of economy coil surface for each 5 sq. ft. of direct steam surface. This is the correct relation for new piping, although for safety a larger percentage is frequently installed.

NET PROFIT OBTAINABLE WITH COOLING COILS.

The all-important reason for economy coils is to reduce the total cost of heating. It will, therefore, be of interest to trace out the net profit obtainable. If we assume, for example, the limit of 70° as the lowest temperature to which the condensate will be reduced from 212°, each pound of steam contains 142 B.T.U. which can be saved.

For what may be considered average results where meters are used, 500 lbs. of steam condensed annually per square foot of radiation may be fairly assumed. Upon this basis, the heat transmitted by 1 sq. ft. of coil surface per season will be 970.4 x 500 = 485,200 B.T.U. This is the total quantity of heat required for heating.

If all or part of the heat in the condensate (142 B.T.U.) is utilized, the total available is 142 x 500 = 71,000 B.T.U., or 14.6% of the total required. Therefore, the total heat utilized from each pound of steam will be 970.4 + 142 = 1112.4 B.T.U., instead of only 970.4 B.T.U. (latent heat). The actual steam needed then will be 485,200 ÷ 1112.4 = 436 lbs. steam furnished, if economy coils are used. 500 lbs. — 436 lbs. = 64 lbs. saved per square foot of steam radiation.

It has been already shown that 1 sq. ft. of economy coil operates in connection with 5 sq. ft. of steam radiation. Therefore, each square foot of coil surface will be the means of saving 64 x 5 = 320 lbs. of steam. If steam is valued at only 50 cents per 1,000 lbs., the value of this saving is $0.50 x (320 ÷ 1000) = $0.16. This is equal to $0.16 (saving by 1 sq. ft. coil) ÷ $0.50 (cost of 1 sq. ft. coil) = 32% interest on the investment in economy coils.

In the accompanying table the values are worked out on various degrees of cooling, with steam at 50 cents per 1,000 lbs., and the assumed annual constant of 500 lbs. per square foot. Other values of steam per 1,000 lbs. and other annual rates per square foot of steam radiation may be readily substituted, if desired.

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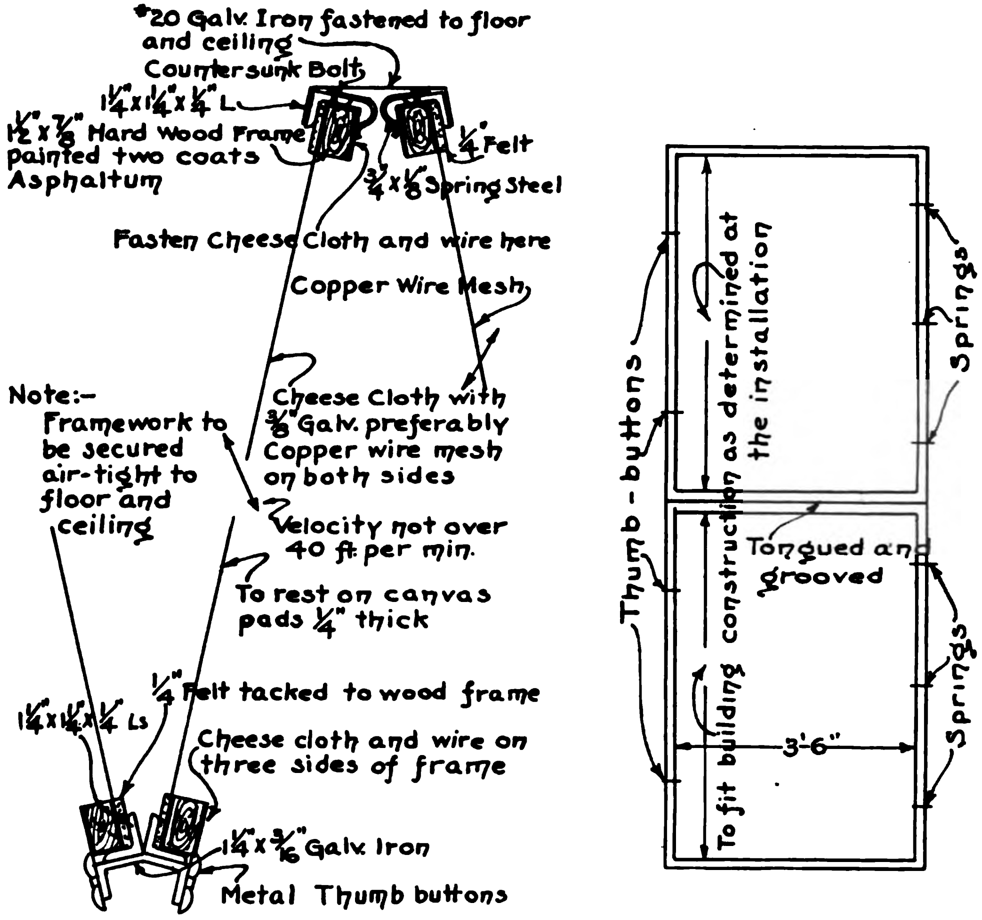
Details of Zig-Zag Air Filters.

The construction of cloth air filters as described and detailed herein refers to those of the zig-zag type. These are arranged with the number of leaves to give the required net filtering area with a velocity of air for and through this type of filter not in excess of 40 ft. per minute.

The framework is constructed of No. 20 U. S. standard gauge galvanized iron, with 1¼x1¼x¼ in. angles, secured air-tight to floors, walls and ceiling by anchor bolts These should be properly formed and stiffened and extended from side to side and from floor to ceiling of the fresh air intake chamber.

The framework is arranged to take the filter frames, the latter resting on canvas pads ¼ in. thick, with sufficient fasteners to maintain a tight joint all around. The


#20 Galv. Iron fastened to floor and ceiling
Countersunk Bolt
1¼"x1¼"x¼" L
1½"x⅞" Hard Wood Frame painted two coats Asphaltum
¼" Felt
¼"x⅛" Spring Steel
Fasten Cheese Cloth and wire here
Copper Wire Mesh
Note:- Framework to be secured air-tight to floor and ceiling
Cheese Cloth with ⅜" Galv. preferably Copper wire mesh on both sides
Velocity not over 40 ft. per min.
To rest on canvas pads ¼" thick
¼" Felt tacked to wood frame
1¼"x1¼"x¼" Ls
Cheese cloth and wire on three sides of frame
1¼"x³⁄₁₆" Galv. Iron
Metal Thumb buttons
Thumb - buttons
To fit building construction as determined at the installation
Springs
Tongued and grooved
Springs
3'-6"

—FRAMES—

—SCREENS—

DETAILS OF ZIG-ZAG AIR FILTER.

filter screens are built in sections convenient for handling, of two rows in height and in area not over 6 sq. ft. for any one screen, and are set in such a manner as to be easily removable for cleaning and repairs from the side where the necessary clearance and access may be obtained.

The filter leaf frames should be built of 1½x⅞ in. well-seasoned white pine, free from knots, and painted two coats of asphaltum. These frames are spread with ⅜ in. mesh galvanized or preferably copper wire netting on both sides of a good quality cheese-cloth of a suitable weave. The cloth is neatly stretched on all three sides of the frames with ¼ in. felt strips tacked to the wood frame as a backing between the frame and angles. The filter leaves should fit snugly to the iron framework, being held in place with metal turn buttons and ¼x⅛ in. steel springs. Allow not less than 18 in. for lateral spacing between leaves.

All woodwork should be properly protected against moisture by waterproof paint or varnish, and all metal parts should be painted two coats.

Where no other access is furnished, it is necessary to provide an access door from inside to outside of the air filter. This may be composed of one leaf arranged with independent frame and fitted with all required brass hardware for its proper hanging.

An extra set of filter leaves, consisting of wood frames, wire netting and cheese-cloth complete, should be furnished for use while cleaning those just removed. A vacuum cleaner may be used to good advantage for such cleaning.

Death of Edward Gurney.

Edward Gurney, president of the Gurney Foundry Co., Ltd., Toronto, Canada, the Gurney Heater Mfg. Co., Boston, Mass., and of the Gurney Massey Co., Ltd., Montreal, Can., died September 18 at his home in Toronto. He was 71 years old. Mr. Gurney had been in failing health for the past two years, but his death came quite suddenly.

Mr. Gurney was a public-spirited man as well as a keen and devoted industrialist. He was a clear thinker and polished speaker and never failed to captivate his audience by the undercurrent of quiet humor which pervaded nearly all his remarks.

He was the only son of the late Edward G. Gurney, a native of Holland Patent, N. Y., who, in company with his brother Charles, laid the foundation in Hamilton, Ont., in 1842, of the well-known foundry business of the E. & C. Gurney Company. Edward Gurney was born in Hamilton in 1845. He received a thorough training as a molder in his father's workshops and, in 1869, on being admitted to the firm, he removed to Toronto, where he was placed in charge of a new branch of the business. From a comparatively small beginning the works at Toronto have become the largest of their class in Canada and take rank with the largest concerns in the United States. In 1891 the firm became incorporated under the name of the Gurney Foundry Co., Ltd., with Mr. Gurney as president.

In addition to his interests in the Gurney Foundry Co., the Gurney Heater Mfg. Co. and the Gurney-Massey Co., Ltd., Mr. Gurney was vice-president of the Gurney Northwest Foundry Co., and president of the North America Life Assurance Co. of Canada. He was a member of the Toronto, National and Automobile Clubs. He also served as president of the Ontario Hospital Association in 1905 and was a governor of Grace Hospital. He was successively vice president and president of the Toronto Board of Trade, in 1896 and 1897.

Those who have been associated with Mr. Gurney in business found him a most delightful man to work with. His cheerful optimism and wonderful determination were a source of encouragement, while his shrewd judgment in matters of business made him a tower of strength in all matters requiring skillful handling.

Mr. Gurney leaves a wife, two daughters and two sons, E. H. Gurney and Cromwell Gurney, who have had the active management of their father's interests for some time.

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Ohio Society of Mechanical, Electrical and Steam Engineers will hold its annual meeting in Columbus, O., November 16, 1916.

A British Tribute to the Superiority of American Pipe.

In a remarkable article which appeared in a recent number of The Ironmonger, of London, on 'The Manufacture of Water Pipes," the author, Percy G. Donald, makes some frank admissions regarding the superiority of American pipe over British, Canadian and German makes, the points including better packing methods, better threading, better manufacturing methods and greater economy in use.

The author refers especially to a project which he had in charge of laying pipe lines in Egypt. In unloading the pipe it was quickly seen that there was going to be a lot of trouble with damaged threads. The ends of the British pipes were protected only by a wrapping of canvas, while the strips of hoop iron screwed onto the ends of the Canadian pipe often left the thread ends exposed. The result was that a large percentage of the threads had to be run over. All of the American pipe was protected by a plate-iron stamping which absolutely protected the ends of the threads. The American pipe ends were also filled with a heavy fat mixed with black lead which prevented rusting, while the British pipes arrived dry and soon began to rust.

The author also calls attention to the greater length of American pipes and the fewer threads to the inch on the larger sizes, both points being commended as being more effective.

Praise is also given to the American practice of having one pipe for gas, water and steam, while the British have three, all of different weights. The American manufacturer, also, has nothing to do with fittings, and this is presented as an advantage.

Finally, in the matter of costs it is shown that the American figures are lower, although the labor costs in America are nearly double those in England, while the distance from the American works to the shipping port is from three to five times that of the British works.

In concluding, the author asks:

What better time than the present to create a proper standard, to scrap our absurd differentiations between gas, water and steam pipes, to scrap such unnecessary sizes as ⅝ in., 1¼ in., 1¾ in. and 2¼ in., to adjust our threads for the larger sizes, to leave to the fittings manufacturer the job of turning out fittings at comprehensive prices, and to make our profits on low costs?

Up to the present the Americans have not got into other markets owing to the differences in their threads. But what is today's position? The export of tubes to foreign countries is prohibited. This means that the greater part of the world is bound to go to America for them, and where once the U. S. thread and pipe is adopted our opportunity of regaining the market is remote, unless our price and our goods are right.

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Firms Now Manufacturing Smokeless Boilers.

An indication of the growing use of smokeless boilers is disclosed in the comparatively large number of firms which are now putting out lines of smokeless boilers to meet the ever-increasing demand. This list, revised to date, includes the following:

LOW PRESSURE STEAM AND HOT WATER BOILERS.

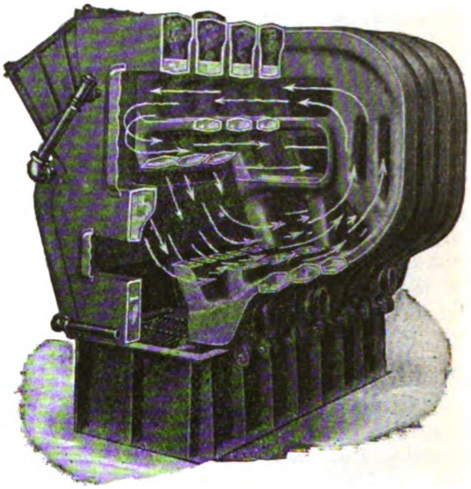
American Radiator Co., Chicago, Ill.
John Brennan & Co., Detroit, Mich.
Jesse C. Coogan, Milwaukee, Wis.
Gurney Heater Mfg. Co., Boston, Mass.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hart & Crouse, Utica, N. Y.
Herbert Boiler Co., Chicago, Ill.
Ideal Mfg. & Supply Co., Oskaloosa, Ia.
Kanawha Mfg. Co., Charleston, W. Va.
Kellogg-Mackay Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Oil City Boiler Works, Oil City, Pa.
Peck-Williamson Co., Cincinnati, O.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Prudential Heating Co., Akron, O.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
United States Radiator Corporation. Detroit, Mich.

FIRE TUBE BOILERS.

Ames Iron Works, Oswego, N. Y.
John Brennan & Co., Detroit, Mich.
Brownell Co., Dayton, O.
Casey-Hedges Co., Cincinnati, O.
Freeman & Sons Mfg. Co., Racine, Wis.
Gem City Boiler Works, Dayton, O.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hawkes Boiler Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Murray Iron Works Co., Burlington, Ia.
John O'Brien Boiler Works Co., St. Louis, Mo.
Oil City Boiler Works, Oil City, Pa.
Titusville Iron Co., Titusville, Pa.
Vogt Machine Co., Louisville, Ky.

Pierce Down-Draft Boiler.

One of the most interesting types of down-draft boilers is the Pierce, manufactured by Pierce, Butler & Pierce Mfg. Corporation, New York, and shown in the accompanying illustration. The distinguishing feature of this boiler is the arrangement of the combustion chamber and the course followed by the fire travel. The draft comes from above the fresh coal, carrying the gases down and through the incandescent body of fire. In this way, it is stated, no gas escapes consumption and thus the boiler is made smokeless in operation, regardless of the kind of coal used. Emphasis is laid on the fact that the major portion of the fire-surface is self-cleaning. It is also pointed out that the location of the magazine is such that it does not occupy valuable heat-absorbing space. The magazine holds enough coal to last twelve hours, in extreme weather, and twenty-four hours, in moderate weather.



CONSTRUCTION OF PIERCE DOWN-DRAFT BOILER.

The fact that any kind and size of coal or wood may be burned successfully in this boiler is, perhaps, its most remarkable feature and attention is called to the fact that the boiler is made up in the sectional push-nipple type, insuring rapid erection while, being of cast-iron throughout, the minimum of oxidization is assured.

Pierce down-draft heating boilers are furnished for both steam and water heating, there being nine sizes of each, the steam capacities ranging from 900 to 4300 sq. ft. and the water capacities ranging from 1500 to 7100 sq. ft.

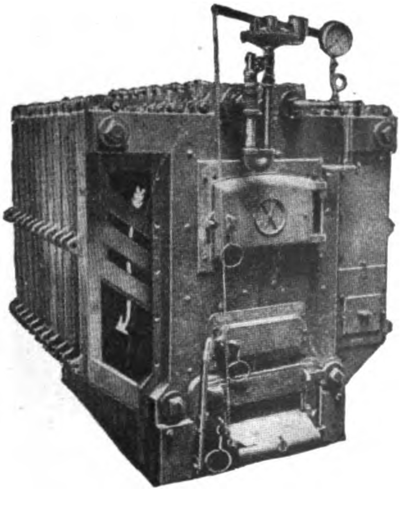
A Single-Grate Smoke-Consuming Sectional Boiler.

An unusual type of sectional boiler, being an adaptation of a pipe boiler first made in 1890, is an interesting product of the Ideal Mfg. & Supply Co., Oskaloosa, Ia. It is designed to be smoke consuming, but has only one grate. Charles Phelps, of this company, states that he has been making smoke consuming boilers of the pipe construction since 1890 which were distributed locally, and many of them are still in use. No changes have been made in them for over 10 years.

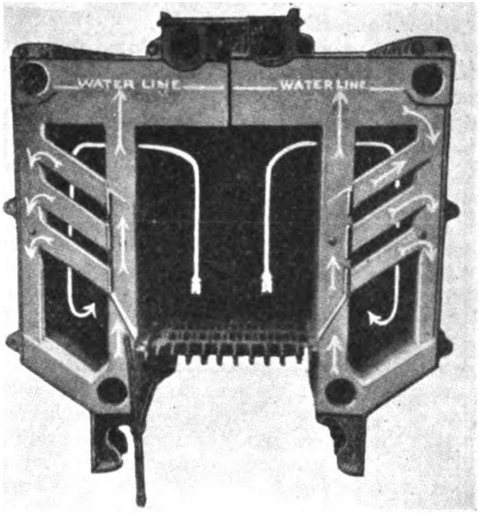
The sectional type which is known as the Phelps Ideal smoke consuming boiler is especially designed for burning soft coal and it is claimed that this boiler will keep steam anywhere from 2 to 10 hours with one soft coal fire, depending on the grade of coal used. In this connection users are reminded that the chimney inside area should be about 25% of the grate area of the boiler and the chimney should be at least ten times as high as the boiler to secure good results.

Smokeless combustion is obtained through the use of the round openings between the sections. These are intended to "allow the blaze from the live coals underneath the grate to pass directly out into the combustion chamber at each side of the fire box and ignite the unconsumed gases that are carried over in the main draft areas."

Among the other construction features it will be noted that the sections are closer together than usual, the sections being 4 in. from center to center. Each section has its own grate, ashpit and draft area. This permits the draft to remain relatively the same with few or many sections. In having all the pipe connections made to the back sections the heater can be enlarged or reduced in size without changing any piping. The narrow sections permit of a large fire surface, this type having 30 sq. ft. of fire surface to each 1 sq. ft. of grate surface.



PHELPS IDEAL SECTIONAL SMOKE-CONSUMING BOILER.



CONSTRUCTION OF PHELPS IDEAL BOILER.

The two top openings near the center of the sections provide a steam header for dry steam. The hottest part of the fire is immediately underneath the header.

This boiler is made in two series, 24-in. and 36-in. for both steam and hot water radiation.

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Smith Smokeless-Furnace Boiler.

Among the recent accessions to the ranks of the smokeless boiler manufacturers is the H. B. Smith Co., Westfield, Mass. This company has recently placed on the market a No. 36 Smith boiler, with and without smokeless furnace, for burning bituminous coals. In addition to this line the company is also about to make a larger boiler with smokeless furnace, to be known as the No. 60 Smith boiler, with 5-ft. grate.

The illustration on page 19 shows the construction features of the 36-in. series. While differing radically from other sectional heating boilers with furnaces designed for the smokeless combustion of soft coal, the Smith boiler with smokeless furnace follows, both in construction and operation, standard practice as seen in hand-fired power boiler furnaces which burn soft coal without objectionable smoke.

In firing this boiler it is pointed out that for a short time after firing the fire doors or dampers in fire doors should be cracked open and they should remain open until all traces of smoke have disappeared, probably for one or two minutes. This excess air, it is stated, increases the efficiency of the boiler, as well as eliminating smoke.

The principal feature, however, in the operation of this boiler is described as the intimate mixing of burning gases with the air which supports their combustion. This, it is stated, has to be accomplished by the design of the furnace. Immediately after the gases have passed through the horizontal openings in the fire box or bridge wall, the gases go through the mixing chamber, terminating in the long, narrow, vertical flue which, it is claimed, mixes the burning gases and the air thoroughly and intimately and enables all the volatile matter to obtain the oxygen necessary for complete combustion.

At the same time the design, it is pointed out, permits the burning gases to be maintained at a temperature high enough for their complete combustion. This depends both upon the design of the furnace and the handling of the fire. Over the fire pot there is formed, between the sections, dead air pockets which, although they are claimed not to hinder the absorption of heat by radiation from the fire, do tend to keep the hot gases away from that portion of the cold surface of the boiler and help to maintain the gases at a hgh temperature.

The so-called coking method of firing is followed with these boilers, fresh coal being placed upon the front third or half of the grate. The volatile gases are driven off and pass over the hot fire on the rear portion of the grate. Here they are raised to the ignition temperature and, passing through the mixing chamber, are mixed with the air and burned.

When the volatile gases have been driven off and the coal has become coked, which requires from one-third to one-half the time between firings, it may be spread over the rest of the fire.

As time is required for the complete combustion of the gases, the combustion chamber in the rear of the boiler is furnished of varying lengths depending on the type of coal burned.

A great advantage of this line, it is pointed out, is that it may be installed as a hard coal boiler up to and including 13 sections without the smokeless furnace and may be adapted, if desired, to the use of soft coal by adding three or four more sections, including the vertical flue, and, if not already in use, the fire back section.

The 36 series (with smokeless furnace) is made in eleven sizes, ranging from 2750 to 5400 sq. ft. steam radiation and from 4550 to 8900 sq. ft. water radiation. The 60 series (with smokeless furnace) will be made in twelve sizes, ranging from 6000 to 11,750 sq. ft. of steam radiation and from 9900 to 19,400 sq. ft. of water radiation.

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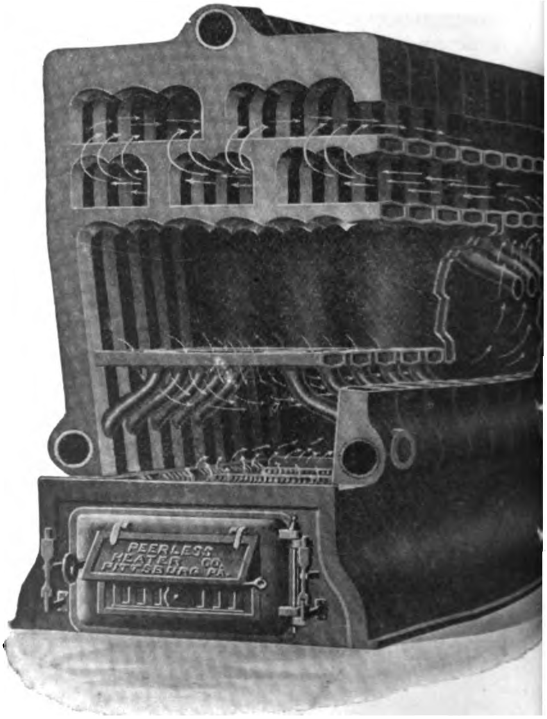
The Peerless Down-Draft Boiler.

Using the well-known principles of construction which are a feature of the Peerless line of steam and hot water boilers and which include the use of cup-shaped or hemispherical arches in the crown plate, as well as S-shaped water tubes or braces, the Peerless Heater Company, Pittsburgh, Pa., has recently placed on the market a down-draft boiler. The accompanying illustration shows the construction of this heater. Special emphasis is laid on the S-arm interior construction which, it is stated, gives in the smaller series an unusually high efficiency. The inside walls of this boiler are V-shaped, as are the other boilers of the Peerless type. The points of the V project into the fire zone, adding, it is stated, one-



CONSTRUCTION OF PEERLESS DOWN-DRAFT BOILER.

third more prime surface than would be the case with a flat wall.

Owing to the greater chimney capacity required for down-draft boilers, the company presents the following table of the minimum sizes of chimney which should be used.

	Size Chimney, In.
Boilers up to 2,075 sq. ft. steam	12x12x40
Boilers from 2,075 to 2,600 sq. ft. steam	12x12x50
Boilers from 2,600 to 3,800 sq. ft. steam	14x14x50
Boilers from 3,800 to 5,000 sq. ft. steam	16x16x65

The Peerless down-draft boiler is made in one series (38) for steam and hot water, with nine sizes in each series ranging from 1,650 sq. ft. steam and 2,700 sq. ft. water to 5,000 sq. ft. steam and 8,500 sq. ft. water.

Recent Tendencies in the Smokeless Boiler Field.

As one of the pioneer down-draft boiler makers of the country a discussion of smokeless boilers would not be complete without some word from A. G. Cripps, vice-president and sales manager of the Prudential Heating Co., Akron, O., and the designer of the Prudential boilers and Cripps down-draft boilers. In recounting his experiences in this field, he writes:

"About 1908 we started to develop an entirely new feature in cast-iron boiler construction, and in doing this we originated the first all cast-iron down-draft boiler placed on the market in this country. We were ridiculed to no small extent by many of the large institutions as to the merits of the undertaking, but so far as the success of the thing is concerned, this is proven, we think, to the entire satisfaction of the trade at large by the fact that every manufacturing concern in the country, with few exceptions, has developed, or is trying to develop, something along the same line in order to hold the trade that is being lost to them by the standard makes of down-draft boilers. Not only are these boilers proving themselves to be a success, so far as the elimination of the smoke nuisance is concerned, where soft coal is burned, but they have invariably developed a saving of from 25 per cent. to 30 per cent. in fuel consumption.

"Not many years back, large buildings, such as school houses, court houses, business blocks, and large churches were heated by the ordinary horizontal tubular boiler. To-day, the cast-iron sectional boiler, and largely the down-draft type, is being given the preference for this class of work.

"The strong tendency, during the past few years, along the line of improving the heating and ventilating in large buildings of a public nature has increased the demand for large boilers and in many instances two, three and sometimes more large units are used to do the work. On account of the valuable space occupied by these boilers, the cast-iron boiler has become very popular on account of its adaptability to smaller spaces than the old horizontal tubular brick-set boilers. The writer knows of several cases where old tubular boilers were worn out, and new boilers bought of the sectional cast-iron type, and the saving in fuel was proven to be 30 per cent., as compared with the previous installation.

"There is no doubt in the writer's mind that the time is near at hand when any boiler of over 3,000 sq. ft. capacity will invariably be specified to be of the down-draft type, as it does not take long nowadays to convince the consuming public of an improvement that is as plainly shown as the development of the down-draft feature."

Smokeless Boilers Here to Stay.

According to J. B. Bernhard, manager of the boiler department of the Kanawha Mfg. Co., Charleston, W. Va., and the designer of the Bernhard water-tube boilers, the smokeless boiler has come to stay.

"In olden times," he writes, "it was said that the direct route to a man's heart was through his stomach, but in the twentieth century it has been discovered that a more direct route is through his pocketbook.

"In the larger cities the dense black smoke from the chimneys of manufacturing plants has caused complaints from the people. This agitation brought about ordinances for the prevention of smoke. The manufacturers, believing that these ordinances would work a hardship on them, and in order to make the laws distasteful to the people, had the ordinances to cover all boilers. Where the ordinances were enforced, it was found that instead of a hardship, the result was a benefit in the saving of coal that was formerly wasted.

"The old method of throwing fresh fuel on a hot fire and causing volumes of dense smoke has been proven very wasteful, while the new method of burning the fuel smokelessly has proven highly efficient and economical. We brought out the Bernhard smokeless boiler expecting to sell it only where smoke preventative ordinances were enforced, and at first this was true to some extent, but at present we are selling a large percentage of these boilers in cities having no such ordinances.

"The great saving of fuel makes the smokeless boiler a wonderful investment. It will not be long before all boilers, except the smaller sizes, will be of the smokeless pattern in territory where soft coal is used for fuel.

"When people learn that the boiler that makes smoke is wasting fuel, they will buy the smokeless type. The man of today is always willing to spend a little extra money when he knows the interest on his investment will be large. The smokeless boiler is a money saver."

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Directions for Firing a Boiler Without Making Smoke.

The following directions are being sent out by the Nashville, Tenn., Smoke Inspection Department in poster form, under the caption "Don't Make Smoke." Directions for firing down-draft furnaces without smoke: To start fire, place wood on top and bottom grates. Light wood. Put coal on top grate. When coal begins to burn, build up fire on upper grate until it is 8 in. thick. Never put coal on lower grate. When fire is started, don't fire any coal bigger than your fist. Carry a thick fire on top grate, 8 in. or more. Keep fire level by firing on bright spots. Don't let any holes burn in fire. Don't poke top of fire.

Slice fire on top grate by running slice bar along grate under fire. Keep fire on bottom grate level and clean. Keep ash pit clean. Clean flues once a day.

Watch your stack. Don't make smoke. If you have trouble in keeping down smoke, call Martin A. Rooney, smoke inspector, City Hall.

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New Books.

THE ENGINEER IN WAR, by Major P. S. Bond, is the subject of a manual describing the requirements that American engineers would have to meet in case the United States should ever become involved in a large war. The author draws freely on the lessons learned by the present European war and the book is replete with illustrations, many of them made from photographs of trenches and other defensive works on the battlefields of France. The book presents a strong argumeut for preparedness on the part of engineers, as well as on the part of the general public. Price $1.50. Published by the McGraw-Hill Book Co., New York, or may be obtained through the book department of THE HEATING AND VENTILATING MAGAZINE.

POWER FOR PROFIT, covering the principles governing the use of machinery and labor in modern buildings, by Reginald Pelham Bolton, has been published by the R. P. Bolton Co., consulting engineers, New York. The volume is broad octavo, 11 x 8 in., 200 pages, handsomely bound in cloth for table use, and has a full index, in addition to marginal notes, red-lettered for ready reference. The book is intended for the use of owners of buildings, operators in real estate, trustees, managers, builders and architects. The cost and the life of machinery in modern buildings and their operating conditions are analyzed in the interests of the income-producing real estate, as well as from the point of view of institutions and of municipal ownership. Analyses are also given of the much-discussed value of exhaust steam for heating purposes and of electric energy regarded as a by-product of steam. In discussing exhaust steam the author makes the point that the value of exhaust steam may be offset entirely by accompanying losses in production. He is referring in this connection to a climate similar to that of New York City where, he says, "the utilization of exhausted steam in the heating apparatus of buildings occupied by the power plants is proved to be no more than one-third of the total steam raised during the year, and this only where the conditions are favorable to such a combination."

Throughout this and other sections the author's arguments are presented tersely, but in a lucid style that adds much to the readableness of the volume.

The whole presentment of the subject is directed towards a reconsideration of existing combinations of machinery by analysis and the reduction of such wastages by the adoption of improved methods and apparatus. These considerations are applied to steam and gas, as well as to electricity. The book may be had directly from the publishers or from the book department of THE HEATING AND VENTILATING MAGAZINE.

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New Publications.

FLOW OF WATER IN WOOD-STAVE PIPE is the title of a new professional paper of the U. S. Department of Agriculture (Department Bulletin No. 376) by Fred C. Scobey, irrigation engineer. The bulletin is based upon the results obtained through a large number of experiments on the flow of water in wood-stave pipes ranging from 8 in. to 13½ ft. in diameter. The work also included the collection and analysis of available records of all previous experiments of a similar character. From the results of all experiments made, there has been deduced a new set of formulas for the flow of water in stave pipes, which is presented in the bulletin.

The bulletin is highly technical in character, and its distribution is limited to engineers and others concerned with the use of wood pipe for conveying water for irrigation, power, municipal, mining, and similar purposes. Application for the bulletin shoud be addressed to the U. S. Department of Agriculture, Washington, D. C.

PROCEEDINGS OF THE NATIONAL DISTRICT HEATING ASSOCIATION'S eighth annual convention, held in New York, May 16-19, 1916, are out in bound volume form, making a book of 470 pages. In addition to the papers, reports and discussions, the volume contains a full list of members, Class A and B members being arranged alphabetically and Class C and associate members being arranged according to States. In addition to the index for the volume itself, there is included an index to the proceedings of previous conventions from 1909 to 1916, inclusive.

DRY PREPARATION OF BITUMINOUS COAL AT ILLINOIS MINES is the title of a new bulletin (No. 88) issued by the Engineering Experiment Station of the University of Illinois, and containing an extensive study of the methods employed in this connection. The data and tables were compiled by Professor E. A. Holbrook. The results are sub-divided into (a) evolution of present preparation practice, (b) standard types of tipples or preparation plants, (c) impurities and breakage of coal, making preparation necessary, and (d) sizing and sizes of Illinois coal. A record is presented of the yearly production of the different sizes of coal in Illinois over a period of 35 years, agreements between operators and miners as affecting preparation are discussed, and requirements for standardization are studied. Copies of the bulletin may be obtained on application to W. F. Goss, director, Urbana, Ill.

HEALTH CONSERVATION AT STEEL MILLS, by J. A. Watkins, passed assistant surgeon, U. S. Public Health Service, is discussed exhaustively in a recent technical paper (No. 102) issued by the Bureau of Mines, Department of the Interior. After taking up medical supervision of employees, fatigue as a cause of occupational disability and the relation of industrial buildings to health of employees, the author has the following to say on the subject of ventilation:

Adequate ventilation of the workshop should be considered from two points of view: (1) That of air renewal; (2) that of removal of products formed in the industrial processes.

The removal of air in a worshop does not differ in essentials from that in any other building; and it is as difficult to formulate any definite rules, for there are so many factors to be considered that each case must be taken up separately. It is preferable that air renewal be accomplished so far as possible by natural means, through windows, transoms, skylights, etc., and attention should be given these fixtures with this end in view. They should be of ample size and readily removable, being preferably on pivots to permit opening in the horizontal or vertical plane. This arrangement will make it possible, also, to control in some degree the air currents and to direct them where desired. Where it becomes necessary to heat the air, steam or hot-water coils may be placed below or near the intakes, windows, ventilators and the like.

The products formed, such as fumes, gases, or dust, and harmful conditions of temperature or humidity incident to industrial processes, must receive additional attention.

The formation, escape, and distribution of dusts can be prevented, or the rust can be removed from the air when once set free. Prevention is far more desirable, and in many instances may be done by sprinkling, as at the stockyards.

Where it is impracticable or impossible to prevent dust from becoming suspended in the air, the process of manufacture that produces the dust should be carried on in a separate, well-ventilated location, as few persons as possible should be exposed, and they should all be required to wear respirators. A respirator should effectively remove all suspended matter from the inhaled air, should be light and comfortable to wear, and should not interfere materially with the respiration; however, a perfectly satisfactory respirator is yet to be devised.

The only effective means of removing dust in workshops is by a carefully designed and constructed exhaust system. The place to collect and remove dust is at its source. Where this is at grinding or mixing wheels a suitable hood of substantial construction, preferably of steel, should be installed.

After systems for the removal of dusts have been installed, there must be frequent inspection and adequate maintenance.

In discussing temperature and humidity, the author says: The combination of high temperature and high humidity in many modern industrial establishments eventually affects injuriously the health of those exposed, especially if the exposure is prolonged or attended by physical exertion. The economic effect of such conditions is a decrease in the efficiency of the worker—that is, a lowering in the amount and character of the work performed. Continued exposure to high temperature and humidity increases the susceptibility to disease and may cause muscular and point pains, aches, cramps, and, in extreme cases, heat exhaustion. Continued exposure will eventually cause anemia and skin eruptions, and tends to induce premature old age. There seems little doubt that the temperature to which many workmen are exposed could be materially lowered and that the duration of the exposure and the amount of physical exertion required while so exposed could be decreased.

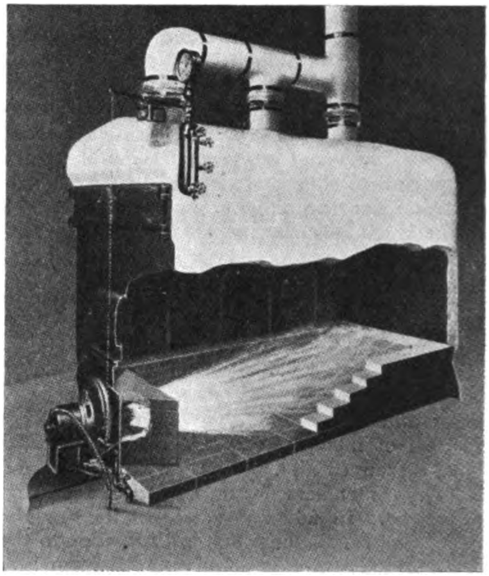
Buildings in which the processes are such as to require those employed therein to be subjected to high temperature or high humidity should be so constructed as to aid, by all natural means, a free circulation of the air. They should be large, with ample floor space. It is of special importance that the roof be placed high and provision made for the escape of heated air. The temperature can also be materially lowered by leaving several large openings in the walls, though undue drafts on those workmen who are overheated should be avoided. A rapid circulation of air created by natural means alone lowered the temperature 30° F. in the working location at one steel plant in the Pittsburgh district.

NEW DEVICES

Improved Rotary Oil Burner.

An improved rotary oil burner, especially adapted for heating boilers, has been brought out by J. C. Johnson, of the S. T. Johnson Co., San Francisco, Cal. The new device is known as the Johnson multiple disc rotary burner, and it is stated that it will produce perfect atomization. The new multiple disc is designed to throw oil from no less than six lips, thus breaking it up and giving the desired mixture. It is well-known that the more perfect the atomization of the oil, the better will be the combustible mixture and the lower air pressure which can be carried.

The new Johnson device sends the oil supply direct to the atomizer, instead of passing through a hollow shaft, consequently there is no packing in the shaft to cause friction.



THE JOHNSON IMPROVED ROTARY OIL BURNER.

Trade Literature.

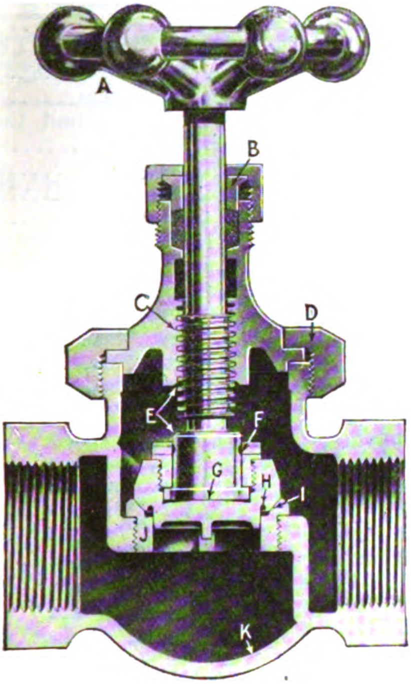
CLARAGE KALAMAZOO MULTIBLADE FANS, described as showing an unusually high efficiency, and noted for their quietness of operation, and guaranteed to be amply strong for working against static pressures as high as 5 in. water gauge, are the subject of a new catalogue issued by the Clarage Fan Co., Kalamazoo, Mich. The company announces that this type has been developed as the result of a series of tests extending over two years and the fans are now presented to the trade with the assurance that they will be found at least the equal of any fan built for handling large volumes of air or gases against comparatively low pressures. For convenience in specifying and ordering, the fans are numbered according to the approximate diameter of the wheel in feet. Capacity and dimension tables are included in the catalogue for each size. The catalogue concludes with George Fitch's skit on Kalamazoo, which starts off by saying:

"Kalamazoo is like New York and Chicago and Shanghai and London and St. Petersburg in one important respect—There is only one of it.

"The man who invented Kalamazoo's name didn't patent it, but he was safe enough. No one has stolen it. For seventy-five years Kalamazoo has struggled along and never has any ambitious young city annoyed it by calling itself 'New Kalamazoo' or 'Kalamazooville' or 'Kalamazoo Center.'

"Thousands of people who don't know whether Kalamazoo is a breakfast food or a new kind of disease have murmured its name lovingly and have taken it home to try on their pianolas. Everybody is familiar with Kalamazoo, but few know whether it is an institution or is played like a piccolo."

American Valves, globe, angle, cross and check, all bronze, of one design only, regrindable and renewable, for heavy and extra heavy service, are a new product of the American Steam Gauge & Valve Co., Boston, Mass., described in a recently-issued catalogue. This company, which has the reputation of being the largest manufacturer of gauges and safety valves in the country, states that the new line has been designed with the express purpose of making it equal, in quality and service, the reputation of American pop safety and relief valves. The valves are offered with the same guarantee that goes with each of the company's long established products. Size 6x9 in. (standard). Pp. 24.



CONSTRUCTION OF NEW AMERICAN GLOBE VALVE.

Connersville Efficiency, a leaflet sent out by the United Vacuum Appliance Co., Connersville, Ind., manufacturers of the Connersville vacuum cleaners, contains the substance of some U. S. Government efficiency tests. The Connersville is compared with several other types of vacuum producers, and shows a higher overall efficiency in each case. The tests, the company states, are authentic proof of the superiority of the Connersville double impeller rotary blower as a vacuum producer, and adds that all Connersville vacuum cleaners are built around this blower. For ordinary uses the company's standard machines are offered as suitable for giving any cleaning results desired. For special conditions the company's staff of engineers is prepared to work out an equipment to meet any given specifications.

Mueller Employees' Annual Outing, describing the field day of the office and factory force of the H. Mueller Mfg. Co., Decatur, Ill., at Fairview Park, Decatur, August 12, 1916, is the subject of a souvenir number of the Mueller Record, the company's monthly periodical. Views are shown of the company's force parading through Decatur's streets, as well as of the principal events at the park. The address delivered by Mayor Dan Dineen, President Adolph Mueller and Attorney A. G. Webber are all given in full. The number will be a lasting record of one of the most notable affairs of its kind ever carried out by an industrial firm.

Some Notable New Sturtevant Catalogues.

If any doubt remained that the fan manufacturers were not giving freely of their knowledge and data to the public at large, it would be dispelled by the notable catalogues recently published by the B. F. Sturtevant Co., Hyde Park, Mass. Two of the latest of these catalogues are entitled, respectively, "Sturtevant Heaters" and "Sturtevant Multivane Volume Fans." Others of the company's recent catalogues are entitled "Sturtevant Electric Fans" and "Sturtevant Economizers in the Power Plants of Paper Mills."

The volume on Sturtevant heaters (Catalogue No. 230 of the Sturtevant Engineering Series) covers the company's line of mitre-type, return bend, London type and solid base heaters, together with pumps and receivers and steam traps. The first part of the book describes the operation, construction and mechanical details of Sturtevant heaters, and is intended for those who are not buying this class of apparatus regularly. The latter part, which gives performance tables, diagrams and dimensions, is for the benefit of engineers, architects and master fitters, and is designed to assist them in choosing the heater necessary for any given building. Diagrams showing proper methods of making steam connections and the space occupied by heaters are also included. The fact that the company has been making heaters for more than forty years is presented as evidence of the class of work turned out. Every detail connected with the design and installation of these heaters, including numerous typical installations, is taken up at length.

The special sections for engineers and architects include one devoted to tables, dimensions and engineering data; another devoted to piping diagrams, pipe sizes and drawing symbols for all types of Sturtevant heaters; a third giving an important series of tables showing temperature rises and condensations for all types of Sturtevant heaters; and a fourth, giving temperature rise curves and miscellaneous information. This volume is 8¼ x 10¾ in., as are the others, and contains 132 pages. An index at the back adds considerably to its usefulness.

The volume on Sturtevant multivane volume fans (Bulletin 228) is equally exhaustive, being taken up entirely with tables of dimensions, capacities, horse-powers, etc. Pp. 100.

The volume on Sturtevant electric fans is prepared with equal care, and features telephone booth ventilators, forge blowers, dust blowers, electric heat blowers, portable ventilating sets, propeller fans, tractrix fans, disc fans, multivane fans (Designs 2 and 3), steel plate fans, monogram fans and steel pressure blowers. Pp. 60.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Michigan Chapter.

The first meeting of the fall season of the Michigan Chapter was scheduled for October 9, in the rooms of the Fellowcraft Club, Detroit, the speaker being Ira N. Evans, formerly with the Evans-Almirall Co., of New York, but now associated with Johnson, Larsen & Co., of Detroit. Mr. Evans's subjeect was "Hot Water Heating."

The present membership of the Michigan Chapter, including the applications now in the hands of the membership committee, is 71.

Massachusetts Chapter.

The Massachusetts Chapter opened its Fall season with a meeting at the City Club, October 10. The subject for discussion was "Automatic Temperature Control and the Early History of Same," by T. F. McCoy, illustrated by lantern slides.

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Petersen-Green.

The marriage is announced of Gustave Petersen, secretary and treasurer of the Heating and Ventilating Magazine Co., New York, to Miss Ethel Gladys Green, daughter of Mr. and Mrs. Fred. D. Green, of Cleveland, O. The ceremony took place September 14 in Cleveland. Mr. and Mrs. Petersen left immediately after for a two weeks' wedding trip in Maine.

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK NOVEMBER, 1916

What Can Best Be Done to Advance the Interests of the Engineering Profession in the United States?

By J. A. L. WADDELL

From an address before the Engineers' Society of Western Pennsylvania, July, 1916.*

It will be well to summarize the undesirable conditions and the alleged deficiencies in the general make-up of American engineers. Those most commonly recognized or claimed are the following:

A. The importance of the engineering profession is not at all adequately recognized by the general public.

B. Engineers as a class are not paid enough for their services.

C. Engineers are not sufficiently often appointed to high executive positions for which their special training and knowledge eminently fit them.

D. In most joint work where a lawyer and an engineer are employed, the lawyer is usually given the leading part and the greater compensation, and the engineer is forced to fill a subordinate position with small pay.

E. Engineers do not take a proper interest in politics; and hence are not given any of the political plums, these going generally to the lawyers and the business men.

F. Engineers are too modest for their own good, hence their great works are comparatively unknown outside of the technical world—and often none too well within it.

G. Engineers as a class are lacking in the ability to speak readily and convincingly in public, and hence cannot influence the masses or guide their efforts towards the accomplishment of important *desiderata*.

H. Engineers are trained too closely along narrow mathematical and technical lines and not in those which develop them broadly as men and as citizens.

I. Engineers, as a class, do not pay sufficient attention to the proprieties, do not dress with sufficient care, do not have sufficient dignity, and rather look down upon a man who concerns himself seriously with such matters of minor importance as personal appearance and the general requirements and trifling obligations of society.

J. American engineers, as a rule, have not a thorough command of their native language in either writing or speaking, owing mainly to the fact that they have been taught to look upon language-study as of far less importance than mathematics or technics.

K. American engineers, because of their narrow training, are not interesting members of society, in that they are unable to converse well upon general subjects, and because they are not keen in regard to any matter that lies without the pale of their professional life.

L. There is lack of ambition and earnestness among the rank and file of the engineering profession, making them content with earning their comparatively small monthly wage and with living a hum-drum life, and preventing them from advancing beyond mediocrity.

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*Pp. 467-564 of the Proceedings.

M. There is as yet no adequate general code of ethics established for engineers; and for that reason the profession cannot stand as high in public estimation as the other professions which have such established codes.

N. There is a lack of harmony among engineers as a body (due possibly to the need of a proper code of ethics, but probably also to a number of other important reasons) which tends to hold back the progress of the profession.

O. The field of activity of the American engineer is too restricted—both from a business standpoint and geographically.

What follows will deal essentially with the remedies for the existing difficulties, defects and general indesirabilities connected with our profession and with the manner in which the interests of American engineering may best be advanced. This subject involves two underlying questions:

First: What are the interests of the profession? and,

Second: What is the limit of their advancement?

Fundamentally, the interests of the profession are inseparably linked with those larger interests of the public which are paramount for the progress of mankind; consequently, it may be stated, without fear of contradiction, that the status of engineering can be improved mainly in one way, viz., by increasing its usefulness to humanity. This object is the true *raison d'etre* of the profession, hence the augmenting of its effectiveness will certainly react favorably upon the aggrandizement of its appreciation by the general public.

The amassing and the consumption of wealth by the people constitute the most important factor in the process of attaining the maximum of material satisfaction for both the individual and the community, which satisfaction is the true measure of national progress; and this can be secured only by a continuous and progressive development of the country's resources. With such development the engineer is directly concerned and he is responsible in a large measure for that development. This, in a broad sense, is the service that he renders to mankind. A keener appreciation by the general public of the engineer's real function in society is greatly to be desired; and its accomplishment constitutes the first effective step to be taken in advancing materially the interests of the profession. This is the psychological phase of the problem. A proper recognition is essential so that adequate compensation may follow.

In order that the engineer's efficiency may increase and that he may be able to respond to the growing needs of a highly complicated society it is necessary that there be a continual growth in professional knowledge to enable him to meet such demands. Again, to render it more certain that a proper compensation will be the reward of the engineering profession, it is desirable that the supply of engineers be fairly well adjusted to the average rate of development of the country so that no large surplus will be forced into competitive methods for obtaining business. A proper balance should be maintained, between the number of engineers of all lines and the total amount of capital available from time to time for investment.

We thus see that the engineering profession is especially interested in securing:

1. Proper recognition.
2. Adequate compensation.
3. Increase of professional knowledge.
4. Proper balance or adjustment of various classes and numbers of engineers to meet the needs of a developing country.

To secure greater recognition requires that a more extended publicity be given to the works of engineers and to the results and effects thereof upon the community in which those works exist. It is not sufficient merely to describe the technical details of a structure or other piece of construction work, but it should be shown how such a structure or construction affects the community by drawing a sharp contrast between the conditions preceding the improvements and those subsequent thereto. It is this that the public can best understand and appreciate.

The life of an engineer may be divided into three epochs: First, from boyhood up to the time of graduation from the technical school; second, as a young engineer in practice while earning his spurs in the profession, say, on the average, for fifteen years, and third, thereafter as an expert in his line of specialization. As the only truth effective way to improve the status of the engineering profession is to augment the efficiency and increase the capacity of the members of which it is composed it will be pertinent to discuss what should be done both for and by the members during each of the three said epochs.

FIRST EPOCH.

The student portion of an engineer's career is by far the best time of his life to produce upon him lasting impressions that will benefit him later professionally and thus tend to aid the profession itself by increasing his efficiency. Unfortunately, it is difficult to get hold of and do anything for the embryo engineer before he enters the technical school, because boys often do not make choice of their calling until they are about ready for college life, and some of them not even then.

The improvements necessary for engineering courses in general in order to increase the efficiency of the students as much as practicable, arranged in the order of their importance, in the speaker's opinion, are as follows:

1. Extending the duration of the course from four to at least five, and, preferably, six years; or else the establishment of separate schools for post-graduate engineering work of all kinds.
2. Arousing the enthusiasm of the entering freshman in respect to the profession of engineer, showing them its grandeur and its usefulness to mankind.
3. Inculcation of a love of study and work for their own sake and not mainly because of the money that can be earned thereby.
4. Instruction as to how best to study so as to save time and labor, or in other words, the economics of mental effort.
5. A thorough, elaborate and systematic study of sound business-English, extended over each year of the entire duration of the course.
6. A general broadening of the course of study so as to include thorough instruction in such important lines as economics, history, oratory and business.
7. Making the study of the Spanish language obligatory, and that of any other foreign modern language optional.
8. Improving fundamentally the study of all foreign languages, so that upon graduation all the students thereof shall be able to read, write and speak them fluently, correctly and gracefully.
9. Study of the art of systemization and its application to all lines of activity.
10. Teaching of ethics for engineers.
11. Accumulation of individual libraries, and showing how to utilize them properly.
12. Establishment of better opportunities for acquiring individual scholastic distinction by the students.

In order that technical education may keep pace with engineering progress, one of two things must be done—either the engineering curricula in the universities and technical schools must be lengthened or else they must be modified so as to cut out some of the more advanced courses, in order to permit of more thorough instruction in the remaining ones and of the addition of many culture studies, leaving those students who desire more complete technical education to obtain it in post-graduate engineering schools. In any case, we certainly need more post-graduate technical courses than are now available for the youth of the United States.

On the other hand, the number of trade schools should be increased so as to provide practical education for artisans, draftsmen and the lower-grade engineers who have not the desire nor the means to take a full technical course.

Too much cannot be said about the ultra-importance to all American engineering students of a thorough command of their native language. Without it their success as engineers is almost sure to be mediocre—or worse. In every year of the entire curriculum there should be courses in the study of English, and in the technical courses themselves the professors should insist upon the employment of good English by all the students in reading, writing and speaking.

For many years the speaker has advocated the obligatory study of the Spanish language in all the technical courses of instruction given in the United States; and since the advent of the present war he has been harping on the subject continually. Our country is destined ultimately to dominate the trade of the Latin-American countries; and the present is the opportune time for the speedy accomplishment of this object.

Much of an engineer's success depends upon the size and character of the technical library which he accumulates. No one can do great work in any profession without having at hand a reference library. This fact should be driven into the minds of all technical students at the beginning of the course of instruction, and they should be reminded of it from time to time by the members of the faculty. It should be considered a deep disgrace for any student to sell a text book after he has finished the course of instruction in which it was employed. If he does so, he is very liable to regret it for many a year. No books can quite take the place of those which one uses at college, even if much better treatises are later available.

SECOND EPOCH.

We shall now pass to the consideration of what can best be done by young engineers in order to advance the interests of the profession. The possibilities may be listed as follows:

1. Continuing study after graduation.
2. Buying books and collecting data.
3. Post-graduate work at some leading technical school, and obtaining of advanced degrees.
4. Joining technical societies.
5. Systemization of work.
6. Adherence to professional ethics.
7. Setting an ultimate goal to attain.
8. Writing technical papers and books.
9. Publicity of achievement.
10. Helpfulness to others.
11. Becoming a useful citizen, attaining prominence in the community, and keeping abreast of the times.

Every practicing engineer should purchase, as fast as they are issued, the various good engineering books, covering the lines in which he is specially interested, no matter how great may be the expense involved. A professional man can get along better without food than without books. He may not have time to read the entire contents of all that he purchases, but he should at least look them over so as to acquaint himself with their field and be able to refer to them when the necessity for so doing arises. A good serviceable technical library is certainly a most important asset for every practicing engineer.

POST-GRADUATE COURSE.

Sometimes there comes to a young engineer, after he has been in practice a few years, an opportunity to take a post-graduate course; and he is truly a lucky man who encounters such an opportunity.

Every engineering alumnus, just as soon as he receives his diploma, should hasten to join (in the lowest grade, of course) the national technical society most directly connected with his line of work; and if there be a local engineering society in the place where he resides, he should join that also. Through the national society he will come into touch with the great engineering problems of the times, and will make the acquaintance of many of the leaders in the profession, provided that he attends the annual meetings and conventions and, if practicable, the regular bi-monthly meetings also; and through the local society he will become interested in state and municipal questions involving engineering, all of which results are greatly to be desired. He should take as active a part as practicable in the affiairs of his technical societies, and should make his services useful and appreciated.

The young engineer should adhere as closely as he can to the ethics of the profession; and, especially, he should avoid subjecting himself to the slightest suspicion of dishonesty or even sharp practice of any kind. An engineer's reputation is as delicate as a woman's, and if it be once really besmirched, it will be found next to impossible to rehabilitate it. The good things that a man does are often very quickly forgotten, but the bad ones are long remembered.

TECHNICAL WRITING.

Nothing will help a young engineer more than the writing and publishing of good technical papers and books, and nothing, except dishonesty, will injure his reputation more than issuing poor ones. Within a year or two after graduation an engineer can properly begin upon a small scale to write technical papers, provided that either he has something new of his own to tell, or that he collects and digests data of real value to the profession that have not previously been adequately compiled; but he should have a number of years of experience before attempting to write a book.

THIRD EPOCH.

We shall now pass to the last division of the subject of this address, viz., what can best be done by the old, established engineers to benefit the profession; and as in the two preceding cases we shall list the possibilities as follows, recording them this time, as nearly as may be, in the order of their importance:

1. The establishment of an American Academy of Engineers.
2. Distinctions and rewards for effective and important services.
3. Acting as advisors to the American Government.
4. Aiding to pass proposed legislation that is favorable to the engineering profession and to prevent all that is unfavorable thereto.
5. Establishment of a clearing house for the employment of young engineers as well as of older ones of minor grade.
6. Improving engineering education.
7. Improving engineering literature.
8. Bringing engineers into closer touch with capitalists.
9. Securing for American engineers important appointments in foreign countries.
10. Placing road-building under the control of engineers.
11. Placing city planning in the hands of engineers.
12. Placing municipal management under the jurisdiction of engineers.

Comment is now in order concerning each of these listed possibilities.

It has long been recognized and often remarked, in both conversation and print, that none of the American technical societies fulfill all the functions of which they might be made capable. Each society falls short of certain of its possibilities of achievement and usefulness.

One of the essentials in which the national engineering societies fail is ethics. They have no adequate code therefor, and they make no systematic effort to enforce what little ethics they recognize, generally refusing to settle disputes among the members anent important matters of disagreement. A court of last appeal is certainly needed by the engineering profession.

Again, the national societies have not in the past made a practice of taking an active part in national and state legislation concerning matters of importance to the engineering profession, as certainly was their duty; nor have they caused their influence to be sufficiently felt at Washington in an advisory capacity in connection with important problems involving engineering.

Recognizing the necessity for a national engineering association of the highest possible standing, to be governed almost entirely by altruistic motives, and devoted to the advancement of both the engineering profession and the nation itself, certain engineers about the end of 1909 made a systematic endeavor to establish an American Academy of Engineers. The attempt was not a success at that time, but the idea of establishing the Academy has by no means been abandoned, for there may be started at any time a move to revive the project.

DISCUSSION.

Samuel E. Duff: I want to take up for discussion one phase of Dr. Waddell's paper which appealed to me. I refer to the organization of the American Academy of Engineers. There are some things in Dr. Waddell's reference to it which appear to me to be particularly important for discussion.

I notice that membership in the Academy is to be restricted to members of what are called the National Engineering Societies.

It seems to me that the organization of engineering societies in this country is fundamentally wrong, and for one particular reason; viz., the National Engineering Societies of this country are divided into societies largely of specialists. I think that principle is fundamentally wrong.

If we are ever going to reach a National Academy of Engineers, I rather believe the probability of the structure of the Academy being carried out along the lines on which this Society is organized and managed, viz., all branches of engineering combined on practically an equal footing as far as the membership and management are concerned.

We have in our society sections for the discussion of the separate branches of engineering, each particular branch in its own way. We are not able to carry that out, possibly, as extensively as we will later. In other words, sometimes the discussion before the structural section of the society may not be restricted to structures only, and the same way in the mechanical section, a subject possibly not restricted to mechanical engineering may be discussed.

But in the majority of cases, each section takes up its own work.

It seems to me perfectly feasible to organize in the United States a series of local societies similar to the Engineers' Society of Western Pennsylvania, working on their own local and definite problems, with which they are extremely familiar. It is also possible to fix the qualification for full membership in these societies by some national convention or other means for national agreement, and it is also possible to set the standards of ethics of the profession by similar national agreement, leaving the local societies to manage their own social affairs and their business affairs in a large degree by themselves.

One other point that I want to speak of in Dr. Waddell's paper is the length of time a student should remain in an engineering school—the six years that he speaks of. This is something I have no right to talk on because I am not an educator, but it seems to me that one of the difficulties we have today is that a great many of the younger engineers go to school too long in the sense that they follow too long a multiplicity of detail in engineering education without the practical experience. I have had a little experience with some graduates of schools who are filled full of such a mass of detail that some of them have forgotten the fundamental principles, and if you happen to get on the line that they think they are going to be specialists in, they will bore you to death with a lot of infinitesimal detail that the practicing engineer, who has to satisfy capitalists and get something done, hasn't any time to listen to. I think one can go to school too long. I think that Dr. Waddell's suggestion of an engineering course of six years should be modified to some extent so that practical work is taken up some time during that course. I think the great defect the engineering graduate has to overcome is that he has not had any definite connection with commercialism, or business, or the fact that everything must be done at a profit—he lacks the connection between that fact and his technical education.

Gardner S. Williams: Referring to the suggestions upon the education of the engineer, the writer heartily endorses the first six. As to the seventh and eighth, making the study of Spanish obligatory, and providing a speaking knowledge of foreign languages, he is very much in doubt. The value of a foreign language lies not alone in the ability to speak it, which latter is ordinarily of purely commercial use. The literatures of France and Germany are a thousand times more valuable to the engineer than is that of Spain, and should be within the grasp of every consulting or designing engineer. For the field man or superintendent of construction they may be of less or perhaps little consequence, and so is Spanish, unless he be brought into contact with Spanish speaking peoples. It therefore seems that the acquisition of a reading knowledge of French and German is of more value to the engineer than is a speaking knowledge of either or of Spanish alone. While it is quite true that much business will be done with South and Central American countries, after all is said and done, only a comparatively few engineers will go there to do it. To the writer's mind the greatest value of the study of a foreign language is in the training it gives in the use of one's own.

In no other way can the proper and distinctive use of English words be so well taught as in the translation of a foreign tongue, and in this particular the Latin language excels all others that have come within the writers' experience.

Dr. T. A. L. Waddell: Concerning the proper duration for engineering courses, I am firmly of the opinion that the time has come to make a fundamental change. I believe that one of these two schemes will have to be followed: Either all first-class engineering courses will have to be extended from four years' to five years' duration, with eleven working months to the year for the students; or else the lower-grade students will have to attend trade schools, the present purely technical four-year courses will have to be curtailed by omitting most of their so-called practical features in order to allow time for more theory, better drill in the fundamentals, and a large increase in cultural studies, and the really fine students who have the ambition to advance beyond the rank and file of their fellows will have to go for one, two, or even three years to post-graduate schools of engineering, where they can be taught all that is generally known to the profession in its various branches. As young Americans are eager to get into harness as quickly as possible and cannot, except in a few cases, be persuaded to devote more than four years to the obtaining of a technical education, it is probable that the second scheme will have to be followed. Should we jog along as we have been doing and give only four-year engineering courses, we shall assuredly drop behind the technical men of Europe—which would be a national calamity.

To Gardner S. Williams' objection to the study of Spanish instead of French, German, or Latin, the author would reply that, in his opinion, the time is coming when quite a large proportion of the technical graduates of the United States will do business in Latin-American countries; and that whether the said time is to be close at hand or distant, depends upon how soon and how thoroughly the Spanish language is taught in this country, not only in the technical schools but also in the high schools and other institutions of learning of minor grade. Mr. Williams agrees with the author that the study of some foreign language is essential for a proper understanding of one's mother tongue, but he believes that either French or German would prove more serviceable than Spanish and that Latin gives the best training of all. The author cannot agree with these views; for his personal experience has proved that a knowledge of French is mainly a gentlemanly accomplishment; and the experiences of many of his friends show that German is of practical use in this country mainly to the pure scientists and only occasionally to practicing engineers. The reason why Latin has proved to be the most serviceable foreign language for training is its almost exclusive use for that purpose in the preparatory schools. Any modern language, however, would be just as effective as the Latin. In this respect he believes that there is no difference in value between French, German, and Spanish.

Newly Collected Data on Heating and Ventilation

By EDWARD B. JOHNSON

(Presented before the Municipal Engineers' Society of New York, as a discussion of the paper by Frank G. McCann, read before that society and presented in THE HEATING AND VENTILATING MAGAZINE *for September,* 1916.)

Experience with the engineers of the New York City departments has indicated a desire for easily accessible data on the subject of the design of heating systems for public buildings and homes. In the following notes have been collected data from a number of sources, with an explanation of their use.

The heat emitted by a radiator in a room should naturally supply the loss of heat from that room. This loss may be considered as due to three causes: that through the glass surface, that through the exposed walls, and the heat required to warm the cold air leaking in or admitted to the room for ventilation. If

TABLE 1—HEAT LOSSES THROUGH BUILDING MATERIALS.

Materials		Heat Units per Degree Difference per Square Foot									Total Loss B. T. U. per Square Foot for Total Differences of Temperature Between the Inside and Outside—Degrees			
Substance	Construction	Peclet carp'n	Germ. Gov't	Aust. Gov't Mac.	Green 1913	Reck. and Reit.	Carlt. F. Twe'd	Harding	Hoffman	Average	60	70	80	90
Glass	*Single window	....	1.09	1.07	0.96	1.03	....	....	1.0	1.02	61	71	81	91
	*Single window (wet)	....	....	....	1.1	....	....	....	....	....	..	..	..	..
	*(Wire glass) single window	....	....	1.04	....	....	1.35	....	....	....	..	..	..	..
	Double windows	....	0.418	0.47	0.41	0.472	0.50	....	0.6	0.48	29	34	38	43
	Single skylight	....	1.118	1.14	1.06	1.090	1.10	....	1.1	1.10	66	77	88	99
	Double skylight	....	0.621	0.48	0.51	0.492	0.60	....	0.7	0.57	34	40	44	51
Brick	Wall, 8 inches thick	0.37	0.46	....	0.39	0.37	0.39	....	0.4	0.40	24	28	32	36
	Wall, 12 inches thick	0.32	0.32	....	0.31	0.29	0.31	....	0.31	0.31	19	22	25	28
	Wall, 16 inches thick	0.28	0.26	....	0.25	0.25	0.25	....	0.26	0.26	16	18	21	23
	Wall, 20 inches thick	0.25	0.23	....	0.21	0.22	0.21	....	0.23	0.22	13	15	18	20
	Wall, 24 inches thick	0.24	0.20	....	0.18	0.19	0.18	....	0.21	0.20	12	14	16	18
	Wall, 28 inches thick	0.22	0.174	....	0.16	0.16	0.16	....	0.19	0.177	11	12	14	16
	Wall, 32 inches thick	0.21	0.15	....	0.15	0.14	0.15	....	0.17	0.16	10	11	13	15
Brick and plaster	8½ inches thick	....	....	0.43	0.37	0.36	....	0.5	....	0.27	16	19	22	25
	13 inches thick	....	....	0.34	0.29	0.28	....	0.33	....	0.31	19	22	25	28
	17½ inches thick	....	....	0.29	0.24	0.24	....	0.25	....	0.25	15	18	20	22
	22 inches thick	....	....	0.24	0.21	0.21	....	0.21	....	0.22	13	15	18	23
	27½ inches thick	....	....	0.21	0.18	0.18	....	0.17	....	0.19	11	14	16	18
Brick furred and plastered	8½ inches thick	....	....	....	0.24	....	0.24	0.41	0.28	0.29	17	21	24	27
	13 inches thick	....	....	....	0.20	....	0.20	0.3	0.217	0.229	14	16	19	21
	17½ inches thick	....	....	....	0.18	....	0.18	0.23	0.18	0.19	11	14	16	18
	22 inches thick	....	....	....	0.16	....	0.16	0.2	0.161	0.17	10	12	14	16
	26½ inches thick	....	....	....	0.14	....	0.14	0.16	0.147	0.147	9	11	12	14
Limestone	Wall, 16 inches thick	....	....	0.56	....	0.43	....	....	0.39	0.46	28	32	37	41
	Wall, 20 inches thick	....	....	0.50	....	0.38	....	....	0.35	0.41	25	29	33	37
	Wall, 24 inches thick	....	....	0.45	....	0.35	....	....	0.31	0.37	22	26	30	33
	Wall, 28 inches thick	....	....	0.41	....	0.31	....	....	0.28	0.33	20	23	26	29
	Wall, 32 inches thick	....	....	0.36	....	0.28	....	....	0.25	0.29	17	21	24	27
Sandstone	Wall, 12 inches thick	....	....	0.58	....	0.45	0.28	....	....	0.44	26	31	35	40
	Wall, 16 inches thick	....	....	0.51	....	0.39	....	....	....	0.45	27	31	36	41
	Wall, 20 inches thick	....	....	0.45	....	0.35	....	....	....	0.40	24	28	32	30
	Wall, 24 inches thick	....	....	0.41	....	0.31	0.23	....	....	0.31	19	22	25	28
	Wall, 28 inches thick	....	....	0.37	....	0.28	....	....	....	0.32	19	22	25	28
	Wall, 32 inches thick	....	....	0.31	....	0.26	0.19	....	....	0.32	19	22	25	28
Concrete	Wall, 4 inches thick	....	....	....	....	....	...	1.07	....	1.07	64	75	86	96
	Wall, 6 inches thick	....	....	....	....	....	....	0.7	....	0.7	42	49	56	63
	Wall, 8 inches thick	....	....	0.49	....	....	....	0.53	....	0.51	31	36	41	46
	Wall, 12 inches thick	....	....	0.43	0.48	....	....	0.36	....	0.42	25	29	34	38
	Wall, 16 inches thick	....	....	0.37	....	....	....	0.26	....	0.31	19	22	25	28
Wood	Clapboards	....	....	....	....	....	....	0.47	....	0.47	28	33	38	42
	Clapboards, paper lined	....	....	....	....	....	....	0.34	....	0.34	20	24	27	31
	Clapboards, sheathed	....	....	....	0.31	....	....	0.3	3 average	0.30	18	21	24	21
	Clapboards, sheathed and paper lined	....	....	....	....	....	....	0.26		0.26	16	18	21	23
	Clapboards, sheathed, paper lined and brick plastered	....	....	....	0.20	....	0.25	0.21	....	0.22	13	15	18	20
	Concrete, cinder fill, 2 inches	....	....	....	....	....	....	0.76	....	0.76	45	53	60	68
	Concrete, cinder fill, 4 inches	....	....	....	....	...	0.6	Don'ly	....	0.6	36	42	48	54
	Concrete, cinder fill, 6 inches	....	....	....	....	....	0.5	0.43	....	0.31	19	22	25	28
	Slate, sheathed	....	....	0.43	....	....	0.43	0.36	....	0.41	25	29	33	37
	Tin, sheathed	....	....	....	....	....	....	0.31	...	0.31	19	22	25	28
	Shingle, sheathed	....	....	....	....	....	....	0.29	....	0.29	17	21	23	26
	Tar and gravel	....	....	....	....	....	....	0.29	....	0.29	17	21	23	26
	Mill tar and gravel	....	....	....	....	....	....	0.2	....	0.20	12	14	16	18
	Shingle roof, sheathed	....	....	....	0.31	....	....	....	....	0.31	19	22	25	28
Doors		....	0.414	....	0.34	....	0.31	....	....	0.35	21	25	28	31
		....	....	....	0.55	0.41	0.48	....	....	0.48	29	34	38	43
	Hardwood, ¾ inch	....	....	0.60	....	....	....	....	....	0.60	41	48	55	68
	Hardwood, 1 inch	....	....	0.63	....	....	....	....	....	0.63	38	44	50	57
	Hardwood, 1½ inches	....	....	0.53	....	....	....	....	....	0.53	32	37	42	48
	Hardwood, 2 inches	....	....	0.46	....	....	....	....	....	0.46	28	32	37	41
Roofs	Corregated iron	....	....	....	....	....	....	....	....	2.17	130	152	174	195
	Tiles, rafters boarded on one side	....	....	....	....	....	....	....	....	0.35	21	25	28	32
	Tiles, rafters boarded on both sides	....	....	....	....	....	....	....	....	0.18	11	13	14	16
Flat roofs	Lead or zinc covered lath and plaster, ceiling under	....	....	....	....	....	....	....	...	0.17	10	12	14	15
	Concrete and steel, laid with asphalt:													
	Concrete, 5 inches thick	....	....	....	....	....	....	....	....	0.30	18	21	24	27
	Concrete, 6 inches thick	....	....	....	....	....	....	....	....	0.28	17	20	22	26
	Concrete, 7 inches thick	....	....	....	....	....	....	....	....	0.27	16	19	22	24
	Concrete, 9 inches thick	....	....	....	....	....	....	....	....	0.25	15	18	20	23
	Concrete, 11 inches thick	....	....	....	....	....	....	....	....	0.23	14	16	18	21
	Concrete, 13 inches thick	....	....	....	....	....	....	....	....	0.21	13	15	17	19
Floor	Joist floor with 1½-inch flooring and lath and plaster under													
	Cold air above	....	....	....	....	....	....	....	....	0.17	10	12	14	15
	Cold air under	....	....	....	....	....	....	....	....	0.07	4	5	6	6
	Concrete and steel, 1½-inch floor laid on concrete, no air space, plaster ceiling:													
	Concrete, 5 inches thick	....	....	....	....	....	....	....	....	0.20	12	14	16	18
	Concrete, 7 inches thick	....	....	....	....	....	....	....	....	0.19	..	..	..	..
	Concrete, 9 inches thick	....	....	....	....	....	....	....	....	0.18	11	13	14	16
	Concrete, 11 inches thick	....	....	....	....	....	....	....	....	0.17	10	12	14	15
	Concrete, 13 inches thick	....	....	....	....	....	....	....	....	0.16	10	11	13	15
	Concrete and steel, 1½-inch floor laid on concrete, air space between concrete and flooring, cold air above:													
	Concrete to 9 inches thick	....	....	....	....	....	....	....	....	0.16	10	11	13	15
	Concrete to 13 inches thick	....	....	....	....	....	....	....	....	0.14	..	..	..	..
	Joist floor with air space and 6 inches of concrete on earth	....	....	....	....	....	....	....	....	0.05	3	10	11	13
	6 inches of concrete on ground, ¾-inch cement screed and 1½-inch wood floor over	....	....	....	....	....	....	....	....	0.25	15	18	20	23
	12 inches of concrete on ground, ¾-inch cement screed and 1½-inch wood floor over	....	....	....	....	....	....	....	....	0.20	12	14	16	18
Partitions	Lath plastered on both sides	....	....	....	....	....	....	....	....	0.33	20	23	26	30
	Match boarding	....	....	....	....	....	....	....	....	0.40	24	28	32	36

*According to hight.

TABLE 2—B. T. U. REQUIRED FOR HEATING AIR.

(This table specifies the quantity of heat in British thermal units required to raise one cubic foot of air through any given temperature interval.)

External Temp. —Deg. F.	Temperature of Air in Room—Deg. F.									
	40	50	60	70	80	90	100	110	120	130
—40	1.802	2.027	2.252	2.479	2.703	2.928	3.154	3.379	3.604	3.829
—30	1.540	1.760	1.980	2.200	2.420	2.640	2.860	3.080	3.300	3.520
—20	1.290	1.505	1.720	1.935	2.150	2.365	2.580	2.795	3.010	3.225
—10	1.051	1.262	1.473	1.684	1.892	2.102	2.311	2.522	2.732	2.943
0	0.822	1.028	1.234	1.439	1.645	1.851	2.056	2.262	2.467	2.673
10	0.604	0.805	1.007	1.208	1.409	1.611	1.812	2.013	2.215	2.416
20	0.393	0.590	0.787	0.984	1.181	1.378	1.575	1.771	1.968	2.165
30	0.192	0.385	0.578	0.770	0.963	1.155	1.345	1.540	1.733	1.925
40	0.000	0.188	0.376	0.564	0.752	0.940	1.128	1.316	1.504	1.692
50	0.000	0.000	0.184	0.367	0.551	0.735	0.918	1.102	1.286	1.470
60	0.000	0.000	0.000	0.179	0.359	0.538	0.718	0.897	1.077	1.256
70	0.000	0.000	0.000	0.000	0.175	0.350	0.525	0.700	0.875	1.049

Above table from F. Schumann's Manual of Heating and Ventilation, pages 41 and 64.

these three losses are found, in B.T.U. per hour, and the sum is divided by the B.T.U. emitted by 1 sq. ft. of radiation surface as found in Table 3, second column, the quotient will be the desired size of radiator for steam heat. For hot water heating use Table 5 and proceed as for steam; or 60% may be added to the amount of radiation as determined for steam.

To determine the heat losses in B.T.U. per hour, use Table 1, in which will be noted losses for the glass, side walls and roof. Table 2 will give the B.T.U. required to heat 1 cu. ft. of air the required amount. One change of air per hour is generally used, though two changes for living rooms with fireplace or when open to a hall, three for entrance halls, and ¾ to 1½ changes for factories, lofts, etc., should be allowed for.

Suppose a room contains the following quantities and is to be heated to 70° F. in zero weather with steam heat:

Glass surface .... G = 100 sq. ft.
13-in. brick and plaster wall .... W = 400 sq. ft.
Cubic contents .... V = 4000 cu. ft.
Temperature difference. 70° F.
(One air change per hour.)

Look up these surfaces in Table 1 and proceed as follows:

G = 100 x 71.......... = 7,100 B.T.U.
W = 400 x 16.......... = 6,400 B.T.U.
V = 4,000 x 1.439...... = 5,756 B.T.U.
One air change per hour.

Total heat loss = 19,256 B.T.U. per hour.

TABLE 3—STEAM RADIATORS—HEAT TRANSMISSION FOR VARYING ROOM TEMPERATURES PER SQUARE FOOT SURFACE.

Room Temperature— Deg. F.	B. T. U. Per Hour.	Pounds of Steam Condensed Per Hour.	Relative Condensation, Pounds.
130	127	0.132	52.6
125	135	0.141	56.2
120	144	0.150	60.0
115	153	0.159	63.8
110	162	0.169	67.5
105	171	0.178	71.2
100	180	0.188	75.0
95	190	0.198	79.2
90	200	0.208	83.3
85	210	0.218	87.5
80	220	0.229	91.7
75	230	0.240	95.8
70	240	0.250	100.0
65	250	0.260	104.2
60	261	0.272	108.8
55	272	0.283	113.3
50	283	0.295	117.9
45	294	0.306	122.5
40	305	0.318	127.1

TABLE 4—RADIATION AND BOILER CAPACITY REQUIRED FOR VARYING ROOM TEMPERATURES.

Room temperatures, Deg. F.	Per cent. of radiation required.	Per cent. of boiler capacity.
130	350.8	185.8
125	316.8	178.6
120	285.8	171.4
115	257.9	164.3
110	233.0	157.1
105	210.4	150.0
100	190.0	142.9
95	171.4	135.7
90	154.5	128.6
85	139.1	121.4
80	125.0	114.3
75	112.0	107.1
70	100.0	100.0
65	89.0	92.8
60	78.8	85.7
55	69.3	78.6
50	60.6	71.4
45	52.5	64.3
40	44.9	57.1

From Table 3 it is noted that 1 sq. ft. of radiator standing in a room at 70° F. emits 240 B.T.U. per hour; therefore 19,256 ÷ 240 = 80.2 sq. ft.

For hot water heat, using Table 5, 19,256 ÷ 150 = 128.4 sq. ft., which is 60% more than the steam surface.

Had the above losses been figured for 80° room temperature and zero outdoors, or 80° difference, the total loss per hour would have been 80/70 × 19,256 = 22,000 B.T.U., but the radiators standing in air 80° will not transmit as much heat, and Table 3, second column, gives 220 B.T.U. per hour as the amount; Table 5 for hot water gives 22,000 ÷ 220 = 100 sq. feet.

This result could be obtained by the use of Table 4, thus: In the second column, opposite 80°, we find 125%. That means that a room requires 25% more radiating surface to heat it to 80° than to 70°.

Radiation to heat room to 70°	80 sq. ft.
Plus 25%	20 sq. ft.
To heat room to 80°	100 sq. ft.

This table is very handy when several room temperatures are under consideration; also when the radiation has been computed by means of either of the following rules which are correct for 70° and some other temperature is desired. Note the rapid increase in the radiation as the room temperature rises.

SHORT AND HANDY RULES FOR COMPUTING RADIATION.

The following rules are based upon the B.T.U. method, assuming standard conditions, i. e., 70° F. indoors and zero outside, that each square foot of glass requires 71 B.T.U., the walls transmit 22 B.T.U., and one air change per hour

$$\frac{G}{5}\quad\frac{S}{10}\quad\frac{V}{150} = \text{square feet of radiation, steam.}$$

$$\frac{G}{3}\quad\frac{S}{7}\quad\frac{V}{100} = \text{square feet of radiation, hot water.}$$

where G = square feet of glass surface.
S = square feet of exposed wall (including glass).
V = volume of room in cubic feet.

Note that S is not the net exposed wall surface, as given in most rules. This saves the labor of subtracting the glass from exposed wall area, which is often forgotten. This subtraction has been done in the formulas.

Another rule, much used, though probably not based on the B.T.U. loss method, is:

$$\frac{G}{4}\quad\frac{S}{10}\quad\frac{V}{200} = \text{square feet of radiation, steam heat.}$$

Should it be desired to determine the heating surface required for any other outdoor temperature than zero, any of the three above rules may be used. Then, by turning to Table 6, note the per cent. required and multiply the result of the rule by this percentage, thus: Suppose

TABLE 5—HEAT TRANSMITTED FROM HOT WATER RADIATORS PER SQUARE FOOT AT VARYING ROOM TEMPERATURES.

Room Temperature, Deg. F.	B.T.U. per Square foot per hour
80*	135.0
75	142.5
70	150.0
65	157.5
60	165.0

* Approximate.

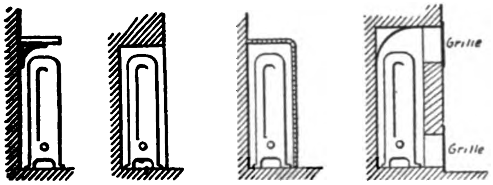
TABLE 6—RADIATION REQUIRED AT VARIOUS OUTDOOR TEMPERATURES (ROOM TEMPERATURE = 70° F.)

Outdoor temperature, deg. F.	35	30	25	20	15	10	5	0	—5	—10	—15	—20
Per cent. of radiation	50	57	64	71	79	86	93	100	107	114	121	129

Rule 1 indicates 200 sq. ft. as the radiation for a certain room. This would be for 70° indoors and zero outside. Suppose the minimum temperature to be allowed for was —20°. Table 6 demands 129% or 258 sq. ft.: 200 × 1.29 = 258 sq. ft.

RECESSED RADIATORS.

When the circulation of air about and through a radiator is interefered with in any way, its efficiency is reduced. According to C. A. Fuller in his book, "Heating and Ventilating Systems," these reductions are as follows:



TYPICAL RECESSED RADIATOR SETTINGS.

Fig. 1	10%
Fig. 2	15%
Fig. 3	25%
Fig. 4	30%

In the case of Fig. 4 care must be taken that the grilles or register faces run full length of the radiator and that the free area of each of the grilles is approximately 3 sq. in. per foot of radiation.

BRONZING AND ENAMELING RADIATORS.

In the Transactions of The American Society of Heating and Ventilating Engineers for 1909, Professor John R. Allen gives the results of his experiments relating to the efficiency of various paints, enamels and bronzes when used for decorating radiators. These experiments demonstrate that bronzes are not as good for covering radiators as enamels and some paints.

It was also shown from the experiments that the number of coats of paint made very little difference, but the kind that was put on last made a very great difference to the radiator's efficiency:

Coating of Radiators.	Comparative Efficiency of Radiating Surface.
Plain, as received from factory	1.005
Aluminum bronze	0.730
Copper bronze	0.752
Terra-cotta enamel	1.038
Light brown varnish	0.977
Silver gray enamel	0.970
Snow white enamel	1.010
Bronze green enamel	0.997
No-lustre green enamel	0.956
Maroon gloss Japan	0.997
White paint	0.987
Terra-cotta paint	1.000
Light green paint	0.989

BOILER CAPACITY REQUIRED.

It is the general practice of reliable boiler manufacturers to rate their boilers upon an 8-hour firing basis, excepting in the very large sizes, where a fireman will be in attendance

The "8-hour rating" can be explained in the following manner: Allowing 20% of the fuel charge to remain unconsumed at the end of the run as a rekindling charge, the remaining 80%, if burned in 8 hours, will produce steam at such a rate as to supply an amount of radiation, standing in still air 70° F., equal to the boiler's rated capacity.

Should the charge be consumed in 4 hours the rate of combustion would be double that of the 8-hour rate and the boiler would care for twice the load of radiation. That is a 1,000-sq. ft. boiler becomes a 2,000-sq. ft. boiler when run on a 4-hour firing basis.

The above shows the necessity of knowing how the rating of a boiler has been determined, as the catalogue rating means nothing unless the firing period be known.

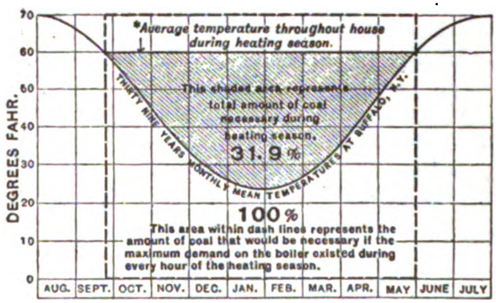
Each square foot of radiation standing

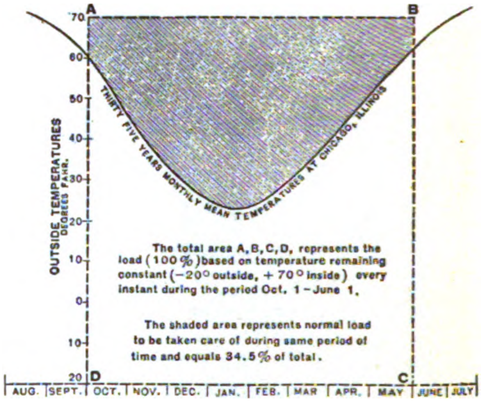
in still air at 70° is considered as requiring ¼ lb. of steam per hour; so rated capacities in square feet may be transformed to pounds of steam by dividing by four and conversely

In choosing the proper size of boiler for any given job, there must be considered the heat losses from the pipes, sides of boiler, possible poor coal and bad draft conditions.

The radiation from covered pipes and boiler may be considered as averaging 25% of the direct radiation installed, and allowing 25% more for poor coal, etc., the boiler would be of 50% greater capacity than the radiation installed.

Thus, if a building has 1,000 sq. ft. of radiation, the proper boiler would be one of 1,500 sq. ft. rated capacity for average conditions and 70° room temperatures.





NORMAL COAL REQUIREMENTS AT BUFFALO, N. Y., AND CHICAGO, ILL., DURING HEATING SEASON.

But suppose another room temperature than 70° is to be used? Table 4, column 3, will give the relative boiler capacity needed considering that needed at 70° as a standard: thus if a building needs 1,000 sq. ft. to heat it to 70° and a 1,500-sq. ft. boiler, to obtain 85° would require 1,000 × 1.39 = 1,390 sq. ft. of radiation, and 1,500 × 1.21 = 1,820-sq. ft. boiler.

Note that the boiler capacity does not increase as rapidly as does the radiation for the reason that as the room temperature rises the radiators become less efficient.

If the heat losses have been computed by the B.T.U. method, Table 3, column 3, will give the steam condensed per square foot of radiation per hour: this, times the total square feet of radiation, gives the steam condensed. Add to this steam condensed in mains and risers; also losses due to boiler radiation, and the sum is the tax on the boiler in pounds of steam. Add sufficient to cover any other losses.

Tax (in pounds of steam) × 4 = catalogue rating of boiler square feet of radiation.

DETERMINING THE COAL CONSUMPTION.

It is generally believed and is probably true that if the prospective purchaser is told that 500 sq. ft. of radiation will require 14 lbs. of coal per hour to keep the radiation steadily filled with steam, he will multiply the 14 lbs. by 5,000 hours (the average length of the northern heating season), showing a consumption of 35 tons of coal, whereas the maximum hourly demand is no indication of the season's normal demand because the entire quantity of radiation is in commission for very short periods, two or three hours per day for a total of possibly ten or twelve days during the entire heating season. The maximum hourly demand indicates 35 tons for a season, while good practice demonstrates that the consumption will be about 10 or 12 tons.

In other words the coal required for a heating season is about one-third the quantity that would be used if all the radiation were in constant use every hour of the day and night.

The above charts show the normal demands at Buffalo and Chicago.

A Survey of Operating Costs in Thirteen School Buildings

Analysis of the Heating and Ventilating Figures in the Jamestown (N. Y.) Public Schools.

By JOHN M. CUSHMAN,

Member of the Board of Education, Jamestown, N. Y.

JAMESTOWN'S PUBLIC SCHOOL BUILDINGS.

POWER-VENTILATED GROUP.

Name.	How Heated.	How Ventilated.	Character of System.	Fuel.
*High			Old	
Sherman Street	Furnaces and steam boiler	Fan driven by electric motor	Furnaces old, steam new.	Hard coal and gas
Fairmount	Steam boilers	Fan driven by electric motor	New	Hard coal and gas
No. 5	Warm air furnaces	Fan driven by gas	Old	Natural gas
No. 6	Warm air furnaces	Fan driven by electric motor	New	Hard coal and gas
No. 9	Steam boilers	Fan driven by electric motor	New	Natural gas and anthracite coal
No. 10	Warm air furnaces	Fan driven by electric motor	Old	Anthracite coal and gas
NO-POSITIVE-VENTILATION GROUP.				
Central	Steam boilers	Gravity	Old	Natural gas, supplemented by anthracite coal ****
No. 1	Steam boilers	Gravity	Old	
No. 2	Warm air furnaces	Gravity	Old	
No. 3	Warm air furnaces and steam boiler	Gravity	Old	
No. 4	Steam boilers	Gravity	Old	
**No. 7	Steam boilers	***	New	
No. 8	Steam boilers	Gravity	Old	

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*This building has such inadequate ventilation that it cannot be properly included in the group with power ventilation, even though there is some ventilation by power.

**This school was not in use for a whole year and does not afford sufficient data for a proper comparison.

***Ventilating fan in each room, taking air from partly-opened window; air exhausted into corridors.

****School No. 7 is heated with hard coal only.

In a survey of the costs to heat and ventilate the school buildings of Jamestown, N. Y., one is confronted at the start with the necessity of dividing the buildings into groups. That there are two natural divisions or groups is apparent if one considers the fact that in one group parts of the buildings are ventilated by a system of forced ventilation, whereas in the other group no forced or positive system of ventilation is in use.

In considering the costs of heating and ventilating the writer has chosen two: the "per pupil" method and the "per unit of size" method. In considering the costs by the "per pupil" method one is liable to overlook many important features of a building which are reckoned with when estimating by the "per unit of size" method.

A most convenient unit of size is the unit containing 1,000 cu. ft. heated and ventilated for a period of one year. In view of wide differences in equipment, a unit of size, based upon cubic contents heated and ventilated, seems the only feasible thing to adopt for purposes of comparison.

By making a study of the various charts, showing the costs to heat and ventilate, per pupil, and per 1,000 cu. ft., it will be noted, there are wide differences in the costs to do the same work in the different buildings of the same group.

It is likely that in any group of school houses there will be one building that, from the point of view of operative costs, might serve as a model building for the group. Whether this particular building answers all the requirements of an ideal school house or not matters but little so long as it serves as a standard by which to measure the efficiency of the rest of the group.

Of the six buildings of the power-ventilated group, the Fairmount School easily takes the place as a model.

In contrast with the Fairmount School certain other schools of this group, notably Nos. 9 and 10, are exceedingly costly to operate.

An effort is made to analyze these great differences in costs by illustrating the continued or increased use of certain kinds of fuel as they relate to the costs.

Even in a model building there are always possibilities for economies by changing fuel, or methods of procuring ventilation.

This survey extends over a period of three years, covering the years 1912-'13, 1913-'14 and 1914-'15.

In determining the cubic contents of the several buildings I have made use of estimates furnished by architects, in some instances measurements furnished by school employees, and in others my own measurements.

The costs have been obtained by reference to the fuel and power bills themselves. Comparisons have also been made, where possible, with such records of costs and other data as are to be found in the office of the Board of Education.

The writer claims but little more for his figures than that they are illustrative rather than exact.

If in one group, the more important group, perhaps, which might be designated as the power-ventilated group, it can be shown that the costs to do the same work, that is, heat and ventilate 1,000 cu. ft. for a year, varies all the way from $1.93 to $4.81, one would have to admit that it mattered little whether these figures were exact to a cent or not.

FUEL VALUES

Value of the different kinds of fuel used in the school houses of Jamestown, N. Y., during the years 1914-'15.

COST OF FUEL

Natural gas, per 1,000 cu. ft.	32½c
Anthracite coal, pea grade, per ton delivered	$4.74
Egg grade, per ton, delivered	5.97

During this same year the school district of Erie, Pa. paid $2.20 a ton, delivered, for a first quality of bituminous coal. The coal was sold under a guarantee as to the heat units.

The B. T. U. values of the above fuels are, approximately:

Natural gas, per cu. ft.	1,232 B. T. U.
Anthracite coal, per lb.	12,679 B. T. U.
Bituminous coal per lb.	14,119 B. T. U.

At the above prices for fuel $1.00 will buy in heat units approximately as follows:

Natural gas, $1.00 worth at $0.32 per 1,000 cu. ft. equals 5,420,800 B. T. U. Anthracite coal, pea, $1.00 worth at $4.74 per ton equals 5,325,180 B. T. U. Anthracite coal, egg, $1.00 worth at $5.97 per ton equals 4,057,280 B. T. U. Bituminous coal, such as Erie bought, $1.00 worth at $2.20 per ton equals 12,707,100 B. T. U.

THE POWER VENTILATED GROUP

In this group of buildings some attempt is being made to comply with the statutes of the State as regards the matter of ventilation. The requirements are that there shall be ventilation that is "positive and independent of atmospheric changes," that there shall be "assured at least 30 cu. ft. of pure air every minute per pupil."

School No. 5 is one of the buildings where the air of the corridors and nearby toilet rooms, at times, is circulated along with, or, in place of the pure fresh air from out-of-doors.

The chief reason for this contamination of the air, delivered to the school room, is that the furnaces are insufficient to properly heat the outside air if the weather is very cold.

It is very evident that the costs to heat and ventilate in this building are too low. The expense to do this work, if it were done thoroughly, and with no taking of air from the interior of the building, would be much higher.

As will be seen by reference to another page there are two other school buildings (Nos. 9 and 10) where at times it may be observed that there is a mixture of the fresh air with the foul air of the corridors and of the toilets.

In these two buildings there is probably no other reason for this practice except that of insufficient furnaces on the part of No. 10, and insufficient boilers in No. 9.

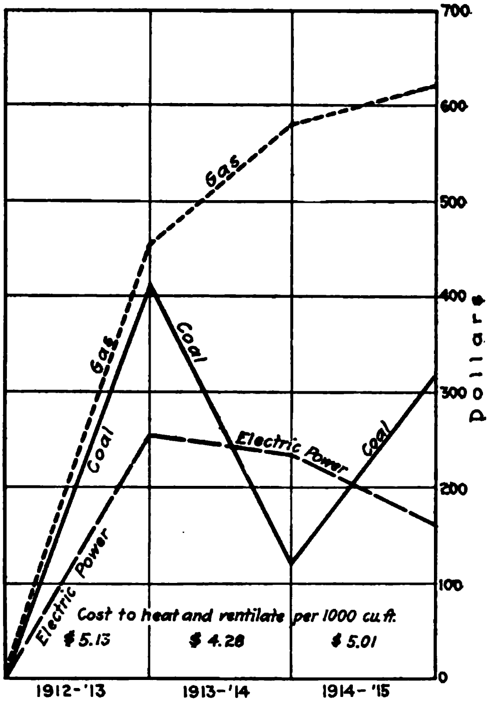
The heating and ventilating apparatus in school No. 5 is old, and furthermore, during severe weather the furnaces in this building are operated at their full capacity, and yet are insufficient to raise the temperature of a proper quantity of outside air to the temperature for a school room.

The only fuel used in No. 5 is natural gas, the fuel value of which is shown on another page.

Furnaces are also in use in school No. 10. The fuel used there being both natural gas and anthracite coal. The fan is operated by an electric motor. The heating apparatus is by no means new. In this building the practice of taking air from the inside of the building during severe weather is aggravated by the fact that the boys' toilet room is situated near the door of the fan room, which is sometimes opened to take the air from the interior of the building. This toilet room is poorly ventilated at the best, the toilet apparatus being of antiquated type that is never free from disagreeable odors.

School No. 9 is equipped with an entirely new heating and ventilating system, the three years which are covered by this survey being practically the three first years of its operation. The source of heat is two steam boilers. The fan is operated by an electric motor. It has been a practice in this building in severe winter weather to open the door of the fan room for the purpose of admitting the air of the corridors and incidently the air of the toilet rooms and the gymnasium.

The fuel used in this building is natural gas and anthracite coal.



HEATING AND VENTILATING COSTS, SCHOOL NO. 9.

The failure to use pure fresh air from out-of-doors entirely and every day in the year is evidently owing to the lack of steam pressure. The pressure in the boilers is kept at a low point as a part of the scheme of heating, which is a "vacuum system."

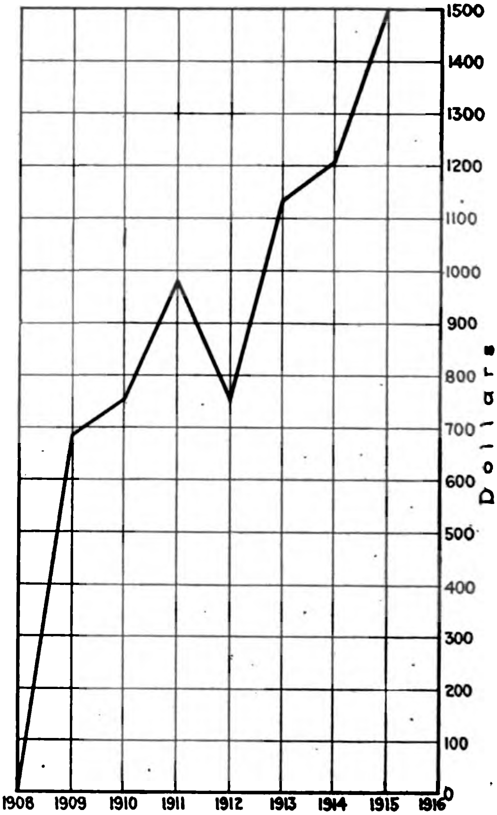
This building is the only one of the group, if not the only one in the city, that is equipped with any sort of an apparatus to regulate the humidity of the air admitted to the school room. During the three years of this survey this particular piece of apparatus was never in use.

It will be noted that school No. 9 is the most expensive to operate of any in this group. And this, too, in the face of the fact that not all is accomplished by the system that is expected of it. Were this system to deliver "30 cu. ft. of pure air every minute per pupil," and do this every school day all winter long, it is safe to assume that the costs to operate would be well above $5.00 per 1,000 cu. ft.

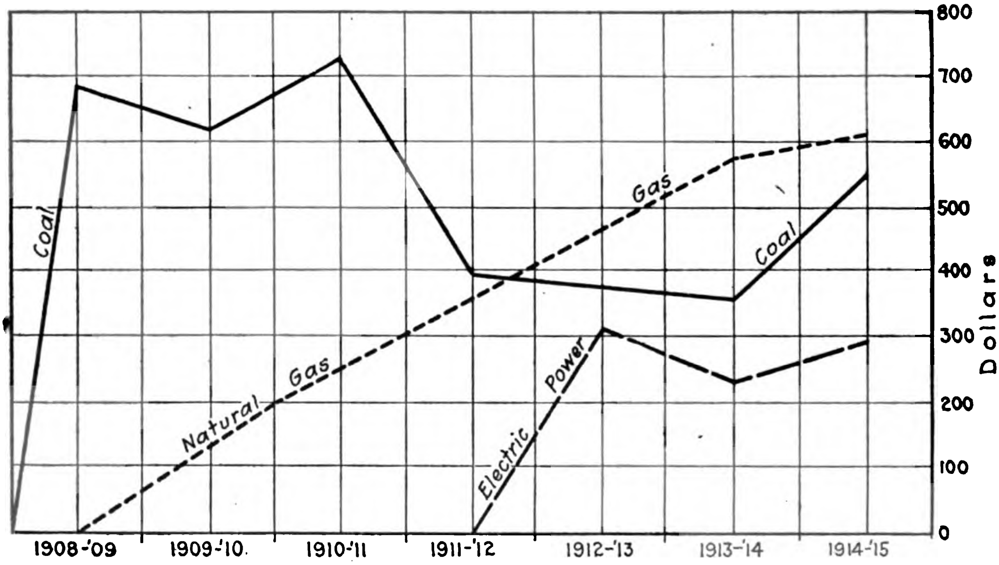
The three remaining buildings of this group are being operated at costs running from $2.31 at school No. 6, $2.34 at the new Fairmount school, to $2.54 at the Sherman Street school.

AVERAGE HEATING COST.

The average cost, it will be noted, is $3.08. In school No. 6 and the Sherman Street school the buildings are thoroughly heated and each pupil is getting approximately the proper quantity of pure air. In the new Fairmount school there is no question about whether the pupils are getting the right amount of air. In this building everything that is required by a statute as regards ventilation is being done with 100 per cent. efficiency and at a cost about one-half of that of school No. 9. The Fairmount school building easily becomes the typical building for the group.



HEATING AND VENTILATING COSTS, SHERMAN STREET SCHOOL, 1908-1915.



DETAILED COSTS OF OPERATION, SHERMAN STREET SCHOOL, 1908-1915.

HEATING AND VENTILATING COSTS, POWER VENTILATED GROUP.

	Three years, 1912-15 average cost per pupil.	Cost per 1,000 cu. ft. to heat and ventilate for the year 1914-'15.
School No. 5	72c	$2.11
School No. 10	$1.43	5.36
School No. 6	1.78	2.52
Sherman Street School	2.20	2.91
School No. 9	2.44	5.01
Fairmount School	2.50*	2.34

*Cost for one year 1914-'15.

AVERAGE HEATING AND VENTILATING COSTS PER 1,000 CU. FT. AND OTHER DATA, POWER VENTILATED GROUP.

	No. 5.	No. 6.	Fairmount School.†	Sherman School.	No. 10.	No. 9.
Average cost, years 1912-'15, to heat and ventilate per 1,000 cu. ft.	$1.93	$2.31	$2.34	$2.54	$4.59	$4.81
Recirculation of the air of the corridors and toilets in extreme cold weather	Yes	No	No	No	Yes	Yes
Apparatus to regulate the humidity of air in school rooms	No	No	No	No	No	Yes, but not in use during the three years.
Automatic heat regulation by thermostat in school room	Yes	Yes	Yes	Part	Yes	Yes
Fire proof doors to boiler or furnace room	No	Yes	Yes	No	No	No
Source of heat	*	*	***	***	*	**

(*Furnaces) (**Steam boiler) (***Combination furnaces and boiler)
† Fairmount School for year 1914-'15 only.

THE GROUP WITH NO POSITIVE VENTILATION.

In the group of school houses with no positive ventilation there is, of course, some ventilation, but such ventilation as there is has been obtained by the "gravity" method. The education law, section 451, requires that ventilation shall be "positive and independent of atmospheric changes."

In the buildings of this group there is no forced supply of air delivered in any definite quantity. The only means of getting fresh air into the rooms is that the heated air of the rooms ascends through ventilating flues that are provided in connection with each room. In the place of this foul or vitiated air a certain indefinite quantity of fresh air finds its way to the school rooms through fresh air ducts.

None of the buildings of this group has automatic heat regulation under the control of thermostats situated in the school rooms. None is supplied with apparatus to control the amount of humidity in the air of the school room.

In two of the buildings, school No. 3 and the Central school, the heating apparatus is situated under the front entrance.

In none of these buildings is there fireproof doors between the boiler room, or furnace room and the rest of the building.

School No. 2 is heated by a furnace, No. 3 by furnaces and a steam boiler, the remaining four of the group by steam boilers.

The fuel used in all of the buildings is natural gas, supplemented by anthracite coal during severe winter weather.

It will be noticed that in this group the average cost to heat and ventilate is about 6 per cent. higher than in the "power ventilated group." While the costs are higher in this group there is no doubt that the actual work done is very much less.

The problem of supplying pure fresh air in the required amount is a most serious one in connection with this group of buildings, for it not only means additional heating facilities, but in each building the installation of some sort of a blower to force the fresh air into the school rooms.

All of these additions, while a serious expense, are absolutely necessary if the buildings are to be operated according to the statutes of the State.

Four of the buildings use natural gas alone as a fuel and the consumption of fuel seems to follow very closely the changes in temperature. Gas fires are easily made to respond to changes in the weather. The buildings using gas exclusively correspond very closely one with another, during the same months, as to costs to heat. This fact furnishes an excellent guide to the weather conditions in Jamestown which, if applied to the heating costs in certain of the buildings of the power ventilated group, would show that some other factor besides weather is responsible for many excessive bills of fuel in that group.

Average heating and ventilating costs per 1,000 cu. ft. No positive ventilation group. Three years, 1912-'15.

Central School	$1.09
School No. 1	1.99
School No. 3	3.98
School No. 4	3.99
School No. 8	4.02
School No. 2	4.51
Average cost	3.26

NO. 9 SCHOOL

In connection with the heating of this building it will be noted that there is a steady increase in the use of gas.

The gas bill for the year 1912-'13 was $463.00; 1913-'14, $582.00; 1914-'15, $621.00. In view of the value of natural gas as a fuel, when considered from the point of view of heat units per dollar, it is regrettable that the use of this fuel should be on the increase.

The coal burned in this building is of the variety known as egg coal and costs nearly $6.00 a ton. This coal has no particular warrant for its use over the cheaper varieties of hard coal except that of ease in handling, and that the fires require less attention.

A change in grates would be about the only expense connected with a change from the expensive egg coal to the cheaper pea coal.

A study of the operation of the Fairmount School would lead one to believe pea coal could well be substituted in No. 9 school with a very substantial saving. This is not, of course, taking into consideration the still greater saving that might be made if soft coal should be substituted for both the gas and the coal now used.

An interesting comparison may be made between this building and the Fairmount school as to the cost to ventilate; the Fairmount School has a contents of about 450,000 cu. ft., the electric power in 1914-'15 cost $187.00, at the rate of about 40c per 1,000 cu. ft. per year.

No. 9 school has a contents of about 219,000 cu. ft., with a cost for power of about $650.00 for the last three years. This was at the average rate of $216.00 a year, or $1.00 per 1,000 cu. ft. per year.

The comparison of costs for electric power, not current used for light or vacuum cleaner, taken in connection with the fact that in the Fairmount School the ventilation is practically perfect, while No. 9, with an expense for doing the same thing poorly, is about 250 per cent. higher, leads one to think that here is a fertile field for improvement.

If one were to look further for a comparison of costs in ventilation, No. 5 school might be compared with any of the electric motor-using schools. The cost to operate the gas engine in No. 5 has been about 13c per 1,000 cu. ft. per year.

If one were to overlook the noise in connection with a gas engine, even the Fairmount School might have the cost to ventilate reduced about one-third.

The annual expense of heating and ventilating school No. 9 of about $1,100.00 might be reduced to something like $350.00 if soft coal could be adopted as the principal fuel and a gas engine be installed instead of the electric motor for ventilating.

Soft coal can be burned without smoke and a gas engine can be operated without a great amount of noise, if properly installed.

It might be mentioned that the outfit for heating and ventilating in No. 9 is practically new. The apparatus was all of a very promising type, yet it had hardly been put into use before it was found to be difficult to operate and, as the charts show, very expensive.

A proposition amounting to $1,400.00

was made to the Board of Education, offering to modify the outfit so as to do away with the seemingly objectionable features of the apparatus. The proposition was accepted and this amount spent, yet there still seems to be much to be done if this building is ever to be operated at as low a cost as are several of the other school buildings.

In the beginning, a steam pump was in operation in No. 9 for the purpose of returning the water of condensation to the boiler. When the $1,400.00 remodeling was undertaken the steam pump was exchanged for an electric motor.

As a practical business proposition the $1,400.00 investment has not shown to good advantage in lowering the costs, as the costs for the year 1914-'15 are only about $28.00, or 2 per cent. lower than they were before making so expensive an addition to an entirely new plant.

In this building the fan is supplying, approximately, 22,950 cu. ft. of air per minute, and there is often the necessity of raising the temperature of this air from 10° F. below zero to 80°.

In order to successfully accomplish this it is necessary to have 81 H.P. developed in the boiler, when working at 5 lbs. pressure. In order that the 2,153 sq. ft. of direct radiation in the class rooms and other parts of the building can also be taken care of at the same time, an addition of 24 H.P. is needed.

To furnish the necessary 105 H.P., in order that the heating and ventilation may be taken care of under the most trying circumstances, there are two boilers of 38 H.P. each, when operated at 5 lbs. pressure.

From the fact that the boilers in this building are being operated at a very low pressure, called "vacuum," which has in reality been about 1¼ lbs. pressure, it is quite evident that nothing like 76 H.P., much less 105, is ever developed in the boilers of this building.

There need be no surprise that the costs to heat and ventilate in this building are practically 500 per cent. above a good average for doing such work.

THE SHERMAN STREET SCHOOL.

It will be seen by the accompanying chart that coal was the principal fuel during the first years of the building's use, natural gas being gradually used more and more each year as is shown by the ascending gas line. During the first years a steam engine was used as the motive power for ventilation. Its abandonment for an electric motor added something in the way of the electric power costs as shown by that line. At about the time of beginning the use of electricity or ventilation there was a substantial enlargement of the building, which accounts for the large increase in the costs of operation over the previous years. However, it will be noted that the total increase corresponds very closely with the increased use of natural gas as a fuel.

It is to be expected that after a building like a school house, once gets into use and the apparatus has had a fair trial the experience thus gained would be reflected in a lowered cost of operation. The reverse seems to have been the rule in this particular building.

In later years a large part of the gas that was burned was used in connection with a steam boiler. This boiler was never intended to burn a fuel of this character, and as a consequence a very large part of the gas was wasted.

The fact that this particular boiler was a source of much waste led the Board of Education to abandon it and erect in its stead a modern type of boiler adapted to the needs of the building.

In spite of the great waste of gas in this building through the continued use of such a fuel the average costs to heat and ventilate run very close to the costs in the Fairmount School.

THE HIGH SCHOOL.

As the demands of the High School long ago outgrew the resources of the heating and ventilating apparatus, it is almost useless to refer to the operation of that school except to deplore its utter inadequacy. There is, however, one item of the costs in this building that is worthy of note as it well illustrates the sort of expenses that have been connected with its operation.

In reviewing the costs to heat and ventilate in connection with the High School, one meets with a series of costs covering the months of November in each year.

For some years it has been the custom

to burn natural gas almost exclusively from the beginning of the school year up until the first of December. At this time the burning of anthracite coal is commenced, quite largely taking the place of gas.

The consumption of natural gas in the month of November for the years
1913-'14 amounted to..........$380.00
1914-'15 amounted to.......... 408.00

If this amount of money each year had been expended for bituminous coal at the prices prevailing in those years, there could have been purchased, approximately

1913-'14......170 tons
1914-'15......184 tons

In order to burn this amount of coal in one month it would have been necessary to have burned the coal at the rate of about 6 tons a day for every day of the month, Saturdays, Sundays and school days.

It is a pleasure to note that the people of Jamestown have voted an appropriation enabling the Board of Education to erect a modern power plant outside the High School building. After the completion of this power house and its equipment with modern appliances we may expect a reduction of at least two-thirds in the costs of heating and ventilating.

SCHOOL NO. 10.

This is one of the two school buildings that are the most expensive to heat and ventilate of any in the city.

The costs in round numbers were as follows:

	1912-'13	1913-'14	1914-'15
Gas	$270.00	$304.00	$276.00
Coal	124.00	185.00	322.00
	$394.00	$489.00	$598.00

If $569.00 worth of soft coal had been purchased during those three years there could have been saved $912.00.

The $569.00 worth of soft coal would have had as many heat units as the hard coal and the gas, and have done the same work in heating.

The cost of electric power to ventilate this building

in 1913-'14 was....$135.00
in 1914-'15 was.... 137.00

This was at the rate of about $1.00 per 1,000 cu. ft. per year.

A comparison between this building and the other buildings of the power ventilated group is, approximately, as follows:

Cost per 1,000 cu. ft. per year:

			cu. ft. per min.
No. 5 school...	$0.13	air delivery	18,000
Fairmount	0.40	" "	34,000
Sherman St....	0.54	" "	32,000
No. 6 school...	0.65	" "	22,000
No. 9 school...	1.00	" "	23,000
No. 10 school..	1.00	" "	18,000

Schools No. 5 and 10 have little more to be ventilated than the school rooms themselves, No. 9 has a small gymnasium, the other three schools have, each of them, a gymnasium and auditorium.

It will be noted that the ventilating costs in No. 5 and 10 for doing practically the same work, viz:—move 18,000 cu. ft. of air per minute, are as 13c is to $1.00.

It seems impossible that all of the 800 per cent. increase in No. 10, over the cost at No. 5, must be charged to the comfort of having an electric motor to operate the ventilating fan, rather than a gas engine.

POSSIBLE CHANGES IN FUEL AND POWER.

A considerable saving may possibly be effected by burning natural gas in those school houses where no janitors are employed during the entire day. In these buildings the principal of the school usually has charge of the gas fires, regulating them according to the weather. The avoidance of janitor hire easily offsets any undue expense incurred by burning gas.

The fact that school No. 2 has been operated at an expense over 400 per cent. above the expense at Central School would lead one to believe that the apparatus is badly in need of attention.

The same may be said of schools No. 3, 4 and 8. The fact that these four schools Nos. 3, 4, 8 and 2 are costing about 400% more to heat and ventilate, such as it is, than it is costing in Central School is an exhibition of administrative inefficiency.

In those buildings where there is a janitor during the entire day and it is thus possible to use such fuels as would enable the building to be operated at a minimum of expense, it might be of interest to take into consideration what the expenses *might have been* had there been different fuel used, or different methods employed to obtain the forced ventilation.

Of the power ventilated group No. 5, the one operated at the least expense, might be considered first.

This building was operated at an average yearly cost of $1.09, natural gas being the only fuel in use. As this fuel has only about 5,000,000 B. T. U. per dollar's worth as compared with 13,000,000 B. T. U. in a dollar's worth of soft coal, one might look for one of two things, if modern boilers or furnaces were to be installed so that soft coal could be burned without smoke, that is, by burning soft coal the expense might be reduced about one-half, or else the expense remaining the same, the efficiency might be increased 100%.

School No. 6 burns both gas and pea coal. The total cost for fuel in this building for the year 1914-'15 was about $580.00. This amount of money when invested in gas and pea coal will only buy the same number of heat units as would $240.00 invested in soft coal. This is figuring soft coal at the price that it was selling at during the years of this survey.

These differences are inducements for furnace changes so as to be able to take advantage of the great difference in heat unit values between soft coal on the one hand and gas or hard coal on the other.

School No. 7 began operating the steam boilers with pea coal. From the commencement of operations, September, 1914 up to December 1, of that year, $366.00 worth of pea coal had been purchased and burned. Beginning with December 1 and covering the rest of the school year there was purchased and used $646.00 worth of egg coal. The reason for changing fuel may be attributed to the fact that there was such unsatisfactory results following the use of the pea coal in the way of excessive ash or unburned coal that it appeared to the administrative officials as advisable to adopt egg coal. While there was a substantial difference noted at once in the amount of fuel completely burned the cost of heat was advanced 25%.

The failure to burn successfully the cheaper pea coal under the boilers in this building was due largely to two causes. First, the pea coal was of a very inferior quality; second, the grates in the boiler were not adapted to burning as small-sized a coal as pea coal.

The chief reason for not trying to make a comparison of the costs to heat and ventilate this building, with the others of the power ventilated group, is as has been stated; because the building was not in full use until well along into the winter. Beginning with December 1, however, the building was practically in use throughout all parts of it. The costs for fuel and power for the period from December 1 until the end of the school year were, approximately:

Coal	$646.00
Power	113.00
	$759.00

It may be of interest to note that $200.00 invested in soft coal would have bought just as many heat units as were purchased for $646.00 when buying hard coal.

So far as the writer can learn School No. 7 was never supplied with the full requirement of pure air, 30 cu. ft. per pupil, per minute, for but one day during the entire year of 1914-'15, and then, for only two hours in that day.

The contract under which the ventilating apparatus was installed in this building called for a motor-generator to be placed in the basement of the school house that should develop an electric current with an intensity of 110 volts.

The ventilating machines, situated one or more in each room, were to be operated by the current from this motor-generator.

After being installed this motor-generator was so controlled by a rheostat as to develop a much lower voltage. The apparatus was run at this lower voltage until the morning of February 25, 1915. Upon that date the inspector of the Education Department of the State of New York, made an official inspection of the ventilation of the school house.

The inspection began at 9 a. m. and was completed at 11 a. m. of the same day. During the two hours of this official inspection the motor-generator was developing a full 110 volts.

Soon after the inspection had been completed the motor-generator was again so controlled by the rheostat as to develop a much less intense current.

Lowering the voltage eventually lowers the work done by the ventilating machines situated in the school rooms.

Less work done, of course, means less cost to operate, and it also means that the pupils get a diminished quantity of pure air.

An increase in operating expenses, occasioned by rigidly insisting that a full supply of air be supplied to the school rooms, can be offset by a saving made in buying low-priced fuel and then burning it upon grates adapted to it.

From the fact that the boilers in this building are entirely new it is not likely there will be any change or other boilers in which soft coal can be burned without smoke.

In this building, as in No. 9 school, there is the problem of raising a large quantity of air from, say 10° below zero to 80°. In this building it is necessary to raise 1,760,000 cu. ft. of air 90°. In order to do this with 5 lbs. of pressure in the boiler 87 H.P. is needed. In addition to this it is necessary to have 44 H.P. to take care of the 3,683 sq. ft. of direct radiation in the school rooms and other parts of the building.

To provide this total of 131 H.P. there is a boiler plant that is capable of developing, at 5 lbs. pressure, 105 H.P.

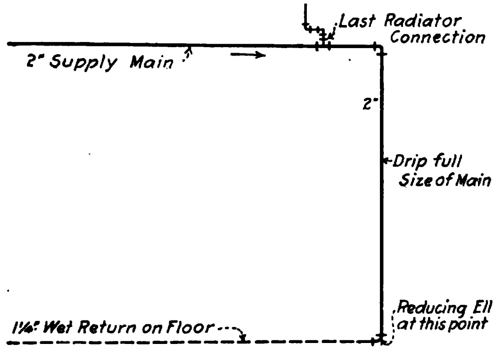
In order to meet with every requirement of the laws relating to ventilation there should be another boiler installed having at least 26 H.P. capacity.

Drips on Steam Piping

By H. S.

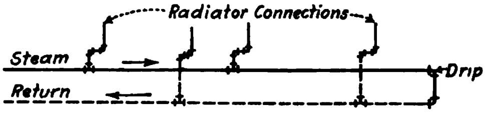
Much has been said and written about the piping of heating systems, but little about the importance of proper drip connections on them. Much trouble, time and expense could be saved if drips on steam piping of heating or drying systems, or wherever steam piping is used, were given the care in design and erection that they warrant.

It is surprising the numerous methods which are employed in dripping a one-pipe steam system. Naturally, most fitters drip the end of the main, differing only in size of drip pipe. The illustration below has been found to be the most successful for one-pipe systems having a wet return.



CORRECT METHOD OF DRIPPING STEAM MAIN IN A ONE-PIPE SYSTEM.

If a dry return system is used, it is customary to reduce the pipe size of the return two sizes. However, in either kind of one-pipe system, better results will be obtained by running the supply main full size at least 1 ft. beyond the last radiator connection before dripping. This also applies in any type of steam-heating system.



INCORRECT METHOD OF DRIPPING STEAM MAIN IN A TWO-PIPE DRY RETURN SYSTEM.

The following method is one used frequently on one-pipe systems. The steam mains are pitched back to the boiler and are dripped at a point close to the boiler. This is not very satisfactory, unless the runs are very short or, if the runs are long, the pipe size must be materially increased in order to get good circulation.

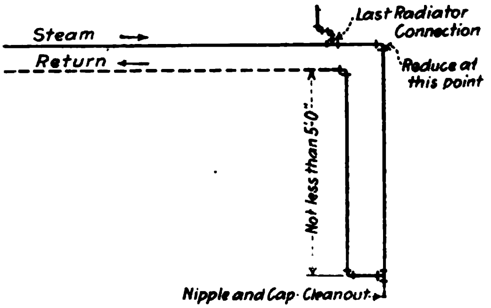
An erroneous but very common method of dripping the end of the main in a two-pipe dry return system is to connect the drip from the steam main directly into the return. Much better results are obtained by loop-sealing the drip before connecting it to the return, as shown by the sketch on next page.

The seal need not be the full size of the main, as a 1-in. pipe is amply large enough for a 2½-in. supply main with a 100-ft. run. This method has been found more successful than the common one, as it prevents the steam from blowing directly into the return without going through a radiator, thereby establishing a slight difference in pressure between the steam and return main, and consequently making a more positive flow through the radiators and minimizing the possibility of the radiators air-binding, which is ordinarily a frequent occurrence with this type of system.

The system of steam heating in which drips play a very important part is the air return or vapor system. In this improved type of steam system, which is very sensitive, the mains must be drained thoroughly at all times or the operation of the system will be affected, usually to a greater extent than an ordinary steam system. In this type of system, as in a single-pipe system, many methods are used to drip the steam mains. A separate drip main, connecting all the drip points and dropping wet at the boiler is required in some vapor systems. This is a very good method, but has the disadvantage of increasing the cost to some extent. Other manufacturers require a special vacuum valve on all drip points before connecting them to the return main. Loop-sealing the drip connection and placing a vacuum valve at the outlet of the seal, then connecting into the return main, is another method used by some concerns. However, probably the most satisfactory and economical way is to connect the drip through a 5-ft. loop seal into the return main.

Satisfactory results have been obtained by the use of all the above-mentioned methods, and all have the same objective, i.e., to pass the water of condensation in the supply mains back to the boiler without lowering the difference in pressure between the supply and return mains necessary for the successful operation of the system. The same variety of methods are used in dripping the mains in a mechanical vacuum system as are used in a gravity vapor system.

The common opinion that high-pressure steam mains do not require as careful dripping as low-pressure mains is incorrect. The reason for the common error is that in a high-pressure main the velocity is so much greater, and for that reason the condensation in a main which is not dripped correctly is carried along by the steam until a drip point is reached, or as in a great many instances where no drips at all are installed, the water is carried up with the steam to wherever the steam is used, in a radiator, cooking kettle or steam jacket. The expense of operation can be lowered in a great many cases in plants where high-pressure steam is used extensively by the addition of drips at low points.



CORRECT METHOD OF DRIPPING STEAM MAIN IN A TWO-PIPE STEAM SYSTEM.

The work done by lifting the condensation by the steam and the additional condensation produced by the steam coming into contact with the cooler water could be eliminated. Most engineers think (if they give it any thought at all) that it does not amount to much, but in a year's time it grows to be a large item.

The Co-Efficients of Heat Transmission Established by the Austrian Engineers.

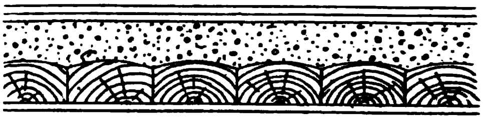
BY A. A. JONES.

(Abstract of paper presented before the Institution of Heating and Ventilating Engineers, in London, October 10, 1916.*)*

Editor's Note.—A paper on the Austrian heat loss co-efficients was presented at the 1908 *annual meeting of The American Society of Heating and Ventilating Engineers, but, due to an error in translation, the figures were found to be nearly twice those ordinarily used in this country. The error was later discovered and the paper, as published in the society's proceedings, is in its corrected form. In the accompanying tables the co-efficient K is expressed in B.T.U. for a surface of* 1 *sq. ft. and* 1° *F. difference in temperature per hour.*

The Austrian co-efficients of heat transmission were established with the greatest care and have been confirmed in practice. The author translated the figures of this document into B.T.U. literally, instead of rearranging the figures for British thicknesses, etc.

The author added that it was advisable to adopt the figures of some reliable authority as a temporary expedient, until the British society is able to set up some definite co-efficients, these latter to be arrived at by means of experiments and, of course, on British materials of construction. By the comparison of these figures with those of Rietschel and the German Union of Heating Engineers, a temporary set of co-efficients could be arranged for the British institution. Then, with the aid of Mr. Barker's promise to devote the laboratory at the University College to this work for making actual tests, the British engineers will be on the right road to enable them to ask architects and even the government to make the figures compulsory.



·FIG·1·

FIG·2

TABLE 1—HEAT TRANSMISSION THROUGH EXTERIOR WALLS.

(The co-efficient, K, is expressed in B. T. U. for a surface of 1 sq. ft. and 1° F. difference of temperature per hour.)

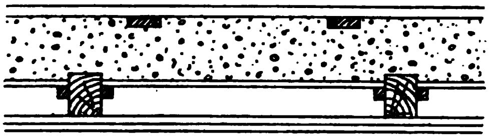
	Brick				Stone	
Thickness, Inches.	With covering inside and out.	Brick with plaster inside.	With air space of 2 ins.	With layer of plaster of 1 in. and air space of 2 ins.	Sandstone.	Limestone.
5.9	0.483	0.530	.....	0.249	.....	.....
11.8	0.319	0.347	0.276	0.198	0.585	0.645
15.7	.....	.....	.....	.....	0.512	0.562
17.7	0.243	0.262	0.198	0.163	.....	.....
19.6	.....	.....	.....	.....	0.452	0.497
23.6	0.194	0.206	0.167	.....	0.407	.0448
27.5	.....	.....	.....	.....	0.370	0.407
29.5	0.161	0.172	0.142	.....	.....	.....
31.4	.....	.....	.....	.....	0.339	.0374
35.4	0.139	0.145	0.120	.....	0.313	0.346
39.3	.....	.....	.....	.....	0.290	0.319
41.3	0.122	0.126	0.106	.....	.....	.....
47.2	0.114	0.116	0.194	.....	.....	.....

BRICK WALL WITH STONE FACING.

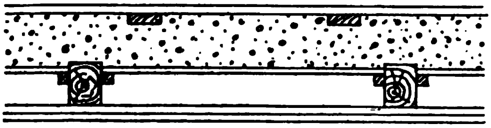
Thickness of the stone, inches.	Thickness of the brick-work, inches.	With lime-stone facing. K =	With sand-stone facing. K =
3.9	5.9	0.376	0.360
3.9	11.8	0.270	0.260
3.9	17.7	0.208	0.204
3.9	23.6	0.172	0.169
3.9	29.5	0.145	0.142
3.9	35.4	0.124	0.124
3.9	39.3	0.114	0.110
9.8	5.9	0.331	0.299
9.8	11.8	0.245	0.227
9.8	17.7	0.190	0.182

COMPRESSED CONCRETE WALL.

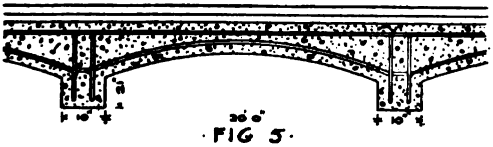
Thickness of wall, inches.	Solid concrete K =	Concrete with air space
7.8	0.501	0.309
11.8	0.432	0.280
15.7	0.378	0.256
19.6	0.335	0.237
23.6	0.303	0.219
27.5	0.276	0.204
31.4	0.253	0.192
35.4	0.233	0.180
39.3	0.217	0.172
43.3	—	0.161
47.2	—	0.153
51.1	—	0.147



·FIG·3·



·FIG 4·



·FIG 5·

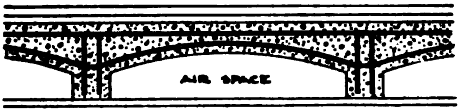
FLOORS AND CEILINGS.

Floor of wood bearers (Fig. 1) with plaster ceiling beneath, and pugging, battens and flooring above. K = 0.055.

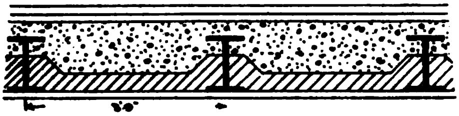
Single wood floor (Fig. 2). K = 0.327.

Floor with joists (Fig. 3) having a layer of plaster, an air space, pugging and flooring. K = 0.1; K' = 0.049.* (K for cold air above and K' for cold air under the floor.)

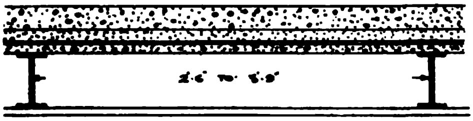
Floor with joists (Fig. 4) having a layer of plaster, an air space, pugging, battens and flooring. K = 0.088; K' = 0.045.*



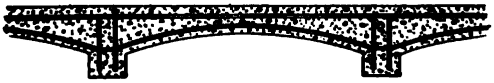
·FIG·6·



·FIG·7·



·FIG·8·



·FIG·9·

Reinforced concrete floor (Fig. 5) with battens and flooring. K = 0.239.

Reinforced concrete floor (Fig. 6) with battens and flooring and layer of plaster on metal lathing. K = 0.237; K' = 0.186.*

Reinforced concrete floor (Fig. 7) having a layer of plaster on metal lathing, the floor of ferro-concrete, properly so-called, pugging, battens and flooring.

---

*K for cold air above, K' for cold air under the floor.

TABLE 2—HEAT TRANSMISSION THROUGH INTERIOR WALLS.

Thickness, Inches.	Brick walls with covering.	Wood partition without covering.	Wood partition with covering each side.	Conglomerate cork wall.	Plaster slab wall.
0.59	.....	0.491	.....	.....	.....
0.78	.....	0.430	0.266	.....	.....
0.98	.....	0.409	0.245	.....	.....
1.18	.....	.....	0.225	.....	0.655
1.57	.....	.....	0.204	.....	0.616
1.96	.....	.....	.....	.....	0.593
2.36	.....	.....	.....	.....	0.573
2.75	.....	.....	.....	0.202	0.540
3.14	.....	.....	.....	.....	0.518
3.54	.....	.....	.....	.....	0.495
3.93	.....	.....	.....	.....	0.477
4.72	.....	.....	.....	0.116	.....
5.9	0.430	.....	.....	.....	.....
9.8	.....	.....	.....	0.059	.....
11.8	0.286	.....	.....	.....	.....
14.9	.....	.....	.....	0.041	.....
17.7	0.225	.....	.....	.....	.....
23.6	0.180	.....	.....	.....	.....
29.5	0.145	.....	.....	.....	.....
35.4	0.122	.....	.....	.....	.....

Joists, in Inches.	K.
6.2	0.147
7.0	0.137
7.8	0.124
8.2	0.120
8.6	0.116
9.0	0.114
9.4	0.110
9.8	0.108
10.2	0.106
11.0	0.098
11.8	0.092
12.5	0.090
13.7	0.081
15.7	0.075
17.7	0.073
19.6	0.071
21.6	0.057

Vaulting of masonry 5.9 in. without pugging:

	K.
With flagstone paving	0.339
With covering of asphalt	0.323
With covering of linoleum	0.331
With flooring on asphalt	0.286

Vaulting of masonry 5.9 in. with pugging.

	K.
With battens and flooring	0.067

ROOFS.

Reinforced concrete (Fig. 8) with layer of plaster on metal lathing, air space, reinforced concrete, pugging of wood sawdust and gravel pugging:

For joists 6.299 in. high and 2 ft., 6 in. to 3 ft. 9 in. wide	0.2
Reinforced concrete roof without air space (Fig. 9)	0.575
Roof with tarred paper on laths 0.984 in. thick	0.436
Zinc roof	0.444
Copper roof	0.444
Slate roof	0.430
Tile roof without laths	0.993
Roof of wood sawdust agglomerate	0.27
Corrugated iron roof	2.129

WINDOWS AND GLAZED LIGHTS.

Thickness of glass, Inches	Single windows.	Skylights.
0.039	1.101	....
0.078	1.095	....
0.118	1.087	....
0.157	1.081	....
0.196	1.073	....
0.236	1.067	....
0.275	1.058	....
0.314	1.052	....
0.354	1.046	....
0.393	1.038	....
Single glass	....	1.146
Double glass	....	0.481

REINFORCED GLASS.

Thickness of glass in inches	0.314	0.314	0.354
Width of the mesh in inches	0.393	0.196	0.236
Diameter of the wire in inches	0.0314	0.0314	0.0393
K	1.052	1.05	1.146

DOORS.

Thickness of wood, inches.	Soft wood Interior doors.	Soft wood Exterior doors.	Hard wood Interior doors.	Hard wood Exterior doors.
0.787	0.440	0.487	0.606	0.684
1.181	0.355	0.387	0.512	0.587
1.574	0.301	0.323	0.466	0.518
1.968	0.260	0.276	0.419	0.483
2.362	0.229	0.239	0.380	0.419

Supplements to add:

For comencing the heating, 20% of the calculated quantity of heat is added in schools and public establishments, with daily heating; in residence work, 15%. In rooms provided with heating aparatus which has to heat not only the room but the incoming fresh air (heating at the windows with fresh air inlet) these supplements can be neglected.

For large-size rooms and rarely used, it is necessary to make a special calculation, as follows:

For the absorption of heat by the solid masonry it is necessary to allow that it penetrates to an internal thickness of 4.7 in. at the temperature of the room.

According to the formula:

$$Wa = GS\ (T-t)\ \frac{1}{z} \text{ in B.T.U., in}$$

which

G is the weight in pounds of the part of the wall 4.7 in. thick.

S is the specific heat of the materials of construction.

T is the temperature to be attained in the room.

t is the initial temperature.

z is the number of hours allowed to attain the desired temperature.

For the loss per hour of heat by the walls, the windows, the floor and the ceiling, the following formula is used:

$Wt = FK\ (T - t)$ in B.T.U., in which F is the surface in square feet of walls, windows, etc., of the room and K the co-efficient of heat transmission.

For heating the air of the room, the following formula is applied:

$$We = 0.24L\ (T - t)\ \frac{1}{z} \times 0.0807 \text{ in}$$

B.T.U. in which L is the volume of the room, 0.24 the specific heat of the air.

ALLOWANCES TO BE MADE FOR DIFFERENT EXPOSURES.

The situation to the north requires a supplement of 29%; to the east and west, 15%; to the south, 0%. For the intermediate situations intermediate figures are taken.

WIND ALLOWANCE.

It is necessary to add 10% for the surfaces particularly exposed to the wind.

HEIGHT OF ROOMS.

The influence of the height of the rooms ought to be taken into account for the rooms of more than 13 ft. high by adapting an interior temperature increasing with the height of the room. By allowing T as the temperature to obtain at the height of the head, the following formula is used:

$$T' = T + 0.014\,T\ (H - 9.84).$$

in which T′ is the temperature at the ceiling, and H the height of the room in feet. The temperature to adopt in the calculations will be $(T' + T) \div 2$.

TEMPERATURE ALLOWED FOR THE ROOMS NOT HEATED.

	Deg. F.
Closed room not heated, placed between two heated rooms........	41
Closed room adjacent to a heated room	32
Cellar	32
Room not heated often connected with the exterior (vestibule entrance)	23
Ground floor without basement under	32
Attic under metal or slate roof....	14
Attic under concrete, tile or paper roof	23

It is necessary to determine the temperature of a room not heated, by considering the heat absorbed or stored by the walls, windows and ceilings.

MEASUREMENTS OF THE VERTICAL COOLING SURFACES.

The measurements to be considered in the calculations are the distance from side to side of the walls by the height or the distance from the floor to the ceiling.

For the windows and doors it is necessary to take the net opening of the brickwork. The surfaces of the windows and the doors are to be deducted from the walls.

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IF ASKED to name the three most important developments in the heating profession during recent years we should list them in the following order: 1. Better technical training; 2. The rise of the engineering catalogue; 3. The development of salesmen engineers. Of these three it must be frankly admitted that the advance in technical training has made the poorest showing, and, for that reason, we believe that more than a casual study should be given to the recommendations presented on another page of this issue concerning "What Can Best Be Done to Advance the Interests of the Engineering Profession in the United States." This paper supplements, in an interesting way, the recent survey conducted by the Chemical Engineers' Society, and on many points, reaches the same conclusions. Much has already been said on this subject, so that it is unnecessary at this time to do more than call renewed attention to the crying need for more and better opportunities for the young heating engineer to acquire what has been tartly described as the "inside dope."

FAR MORE encouraging is the advance shown in the development of the engineering catalogue, which has now assumed a commanding position in the field of trade literature. The recent appearance, for instance, of two fan data manuals, together with newly-issued "bulletins" on humidifying and air conditioning in general, furnish convincing proof, if any were needed, that the bombastic, "best-ever" claims of the old line catalogues have given way for good to the convincing performance-data arguments of the modern catalogue. In fact, it may well be asked whether the modern engineering catalogue is not the answer to the demand for more practical sources of information than are afforded by the ordinary hand-books. There is no denying that there is such a demand, especially when it is considered that in one city alone a class of eighty young men actively engaged in the profession may be found enrolled for night study of the art of heating and ventilation.

Finally, there is the recognition of the fact that the salesman of the future in any mechanical trade must be an engineer. The day of the smooth-spoken, but uninformed, "good fellow" is inevitably passing in favor of the man who can talk to his client in his own language and confer with him on his particular use of the product in question.

As a result of the developments cited, the heating profession is advancing more rapidly, perhaps, than any other, and while the young engineer is being urged and pleaded with to do his share towards the up-building of the profession, such as taking more interest in his chapter or other association interests, there is even greater need of warning him that he is likely to be left in the ruck if he fails for a minute to keep up with the significant movements now going on in his field.

THE CONSULTING ENGINEER

The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

Conducted by Ira N. Evans.

66—Heating With Exhaust Steam From Steam Hammers.

QUESTION: The writer has a proposition of laying out and installing a heating system where it is intended to use the exhaust steam from steam hammers. I would like to know what is the most practical method of measuring and how to arrive at a proper charge; that is, whether it is best to make a charge on a B.T.U. basis or for the condensation returned.

ANSWER: This question involves many points not stated. The writer will try to answer the question in several ways, hoping a suggestion may be obtained as to the proper course to pursue.

It is not clearly indicated, for instance, whether it is desired to measure the entire amount of steam used by the hammers or only that portion used for heating. In utilizing steam from steam hammers it should be recognized that they are very intermittent in operation; that is, they will exhaust a large amount of steam for a short period and then be idle for an equal interval. Where the heat required for heating is a comparatively small portion of the maximum output, the flow would be comparatively steady, or where the hammers were in sufficient number, the fluctuations of the whole would not be so great.

Where there is a fluctuating power load, there will be a certain amount of live steam used to maintain a constant pressure and some steam will be lost through the back pressure valve. It is of vital importance that the back pressure on the steam hammers be constant, so as not to interfere with the operation of the hammer. If the back pressure varies between fairly wide limits, the operator cannot tell how wide to open the throttle to deliver blows of proper intensity. In some plants the operators will not permit any back pressure at all, due to the variations on the exhaust side of the hammer.

It is also to be remembered that, due to the resistance and variable back pressure, more steam will be used by the hammers than if they were exhausting free, without any back pressure.

If it is desired to measure the steam for both hammers and heating, a steam flow meter should be used, placed in the high pressure line. Such a meter should be of the integrating type and, if your pressure conditions are nearly constant, fairly accurate results can be obtained. If it is desired to measure only the heat used by the heating system, a condensation meter, with proper cooling coil and trap, should be adopted. The latter, however, will not take account of the extra steam used by the reducing valve or that wasted through the back pressure valve during periods of light and peak loads.

If both flow meter and condensation meter are used and the extra live steam due to back pressure, etc., is determined with the heating on and off, one can obtain a very fair estimate of the steam used. If by a B.T.U. rate a flat rate is meant, the writer does not believe this would be equitable either to the seller or purchaser.

Another method is to place the flow meter on the live steam connection to the heating system only and, with the condensation meter, the total steam required for heating will be obtained. This would not, however, show the increased steam due to the back pressure.

The relative amounts required for heating and the steam available from the hammers will be the determining factor. With a given back pressure the increased steam consumption will be nearly constant for each size machine, and may possibly amount to very little.

The increased steam consumption on hammers, due to back pressure, and all live steam used to maintain the pressure constant, should all be charged to the heating. When the total pounds of condensation are determined from the meters, there should be subtracted the heat in the liquid as it goes to the sewer at, say, 200° F., which is 168 B.T.U. per pound, from the total heat in the steam at the pressure at which the back pressure valve is set, say, 5 lbs., or

1,158.8 B.T.U. There will then be condensed in the heating system 988 B.T.U. per pound of condensate.

The live steam, however, should be taken at the pressure outside the reducing valve before entering the system. If, for instance, it is 80 lbs. gauge, or 1,185.4 B.T.U., the heat value per pound will be 1,185.4 — 33 = 1,152 B.T.U. for all steam passing through the flow meter to the system.

In case the conditions are different from those cited above, the proper quantities can be looked up in a steam table and proper determination made. If no return condensation gets back to the plant, the heat used on the system should be calculated from the initial feed water temperature to the final pressure at the reducing valve.

67.—Figuring Heat Output of Copper Coil Heaters.

QUESTION: There seems to be a teendency to use copper coil heaters, designed for storage tank purposes, for heating small houses. In your opinion is this economical, as compared with the regular cast-iron gas heaters of the Simplex or Bryant type? Also, what would be a fair estimate of the number of B. T. U. that could be transmitted through the tubing to the water? In checking over several heaters I find that in some it is as low as 3,000 B. T. U. per square foot of tubing and in others as high as 10,000 B. T. U. per square foot.

Take, for instance, a certain storage heater containing 200 lin. ft. of ¾-in. copper tubing that, when used as a house heater, has a rating of 1,600 sq. ft. of radiation.

1 lin. ft. of ¾-in. tubing has 0.201 sq. ft. of surface.

200 × .201 = 40.2 sq. ft. of heating surface.

1,600 × 250 = 400,000 B. T. U. capacity of heater.

400,000÷40.2=9.950 B. T. U. per sq. ft. of tubing.

Its storage heating capacity is listed at 6 gal. per minute. It will require approximately 1,170 B. T. U. to heat 1 gal, of water per hour through 140° F., say, from 40° to 180° F. 400,000÷1,170 = 342 gal. of water per hour. 342 ÷ 60 = 5.7 gal. per minute, which is a trifle less than its listed capacity.

If natural gas is used to do the heating and we allow 900 B. T. U. per cubic foot for the gas, it will take 400,000 ÷ 900 = 444 cu. ft. of gas per hour and will cost 444 ÷ 1,000 x 30 cents = 13.3 cents per hour when running at full capacity.

ANSWER: As far as economy is concerned, we would say that if the heating surface is efficient and sufficient, in proportion to the gas burned, it would make little difference as to the form of heater. When extracting heat from hot gases, the free movement of the water on one side and the hot gases on the other are all that govern the rate of transmission, the temperature difference being the same.

The only comparison the writer has to go by is the transmission as shown by our correspondent's figures of 9,950 B. T. U. per square foot per hour, and if there were 800° F. average temperature difference between the water and gas, it would mean a transmission of 12.5 B. T. U. per degree difference per hour. This has been equaled by fan coils, in some cases, of high velocities and wide differences in temperature, as with high pressure steam.

In calculating the cubic feet of gas, with 900 B. T. U. per cubic foot, nothing has been allowed for the heat lost in the products of combustion which would surely amount to a great deal proportionately, under the conditions assumed. The economy of operation of such a coil, if the heating surface is short, is reduced, but the capacity can be maintained by burning more gas and allowing the products of combustion to pass off at higher temperatures.

The process is analagous to that in a house heating boiler when the heating surface is short. By maintaining a high flue temperature and a high rate of combustion, the capacity can be maintained within fairly wide limits by burning more fuel at the expense of economy.

The writer would suggest that our correspondent connect up one of these gas heaters with a range boiler, the capacity of which can be easily determined. Place thermometers on the water inlet and outlet, and shut off all lines to the house. Place another thermometer on the outlet of products of combustion of the heater, also shut off all gas to the rest of the house and read the meter before starting and after completing the test. The temperature of the products of combustion will give the loss in the flue, and the time to heat the boiler to temperature (shown on outlet and inlet water thermometers) will give the work accomplished in the interval of time for the cubic feet of gas, as shown by meter readings.

By regulating the rate of flow of gas it will be easy to determine the most economical capacity and combustion rate for any given amount of heating surface in a heater. If these results are plotted in a curve, it will be possible to find the most economical method of operating the heater. This experiment can be arranged at slight expense in almost any house having street gas and city water. The results might not be absolutely accurate, due to the radiation of the surface of the range boiler, if not covered, but by testing two heaters of different types with the same readings on the water thermometers, a fair comparison could be made.

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Maintaining a Running Balance in High-Speed Machinery.

The importance of running balance in high-speed machinery is well understood. Under the title of "Dynamic Balance," a paper on this subject was recently presented before the American Society of Mechanical Engineers, by N. W. Akimoff, engineer for the Dynamic Balancing Machine Co., Philadelphia, Pa.

In this paper Mr. Akimoff described a machine which he has devised for correcting the condition of dynamic unbalance. This is a matter of importance, not only in power plants, but in all hotels, hospitals, etc., where the annoyance due to unbalanced machinery is often serious. Such machinery may include turbines, centrifugal pumps, electrical apparatus, etc., as well as fans and blowers.

After discussing the principles involved Mr. Akimoff stated that a machine to deserve the name of dynamic balancing machine must indicate the plane of unbalance, as well as the numerical value and sign of the unbalancing couple. In the machine illustrated herewith he claims to have produced such a device.

A rigid horizontal beam (Fig. 1) is hinged at one end and supported by a spring at the other. The body to be tested, already in perfect static balance, is rotatably supported on the beam. If dynamically unbalanced the body will, when rotated, cause the beam to vibrate in a vertical plane, with a period of oscillation equal to the period of rotation of the body. In other words, if the speed of the unbalanced body is, say, 315 R.P.M., the beam will vibrate at the rate of 315 complete oscillations per minute, quite regardless of the characteristics of the spring (except possibly at the very beginning of motion).

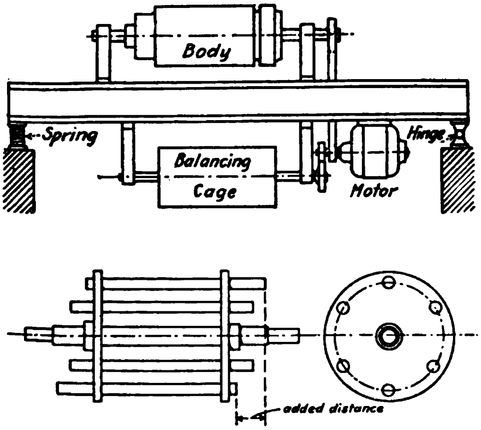

FIG. 1—CONSTRUCTION OF SQUIRREL CAGE.

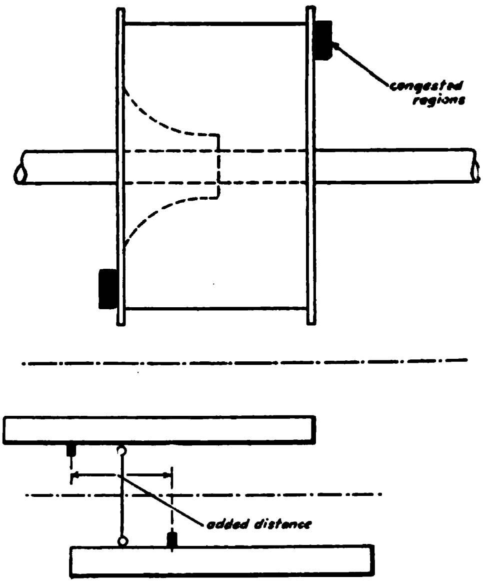

FIG. 2—DYNAMIC UNBALANCE IN SPECIAL FAN.

Now imagine a second body, exactly similar in every respect to the first, also in perfect static balance, but dynamically unbalanced to precisely the same extent as the first body, temporarily associated with the same beam, say suspended under it.

If these two bodies are oppositely located as to balance and run precisely at the same speed (synchronously), then the unbalancing or disturbing couples will cancel out, and the beam will have no tendency to vibrate, no matter how badly unbalanced, individually, are the two bodies. This is the fundamental principle of the machine, to determine unbalance by determining the unbalance necessary to neutralize its effect.

In the actual machine, instead of a second body being an exact image of the original unbalanced body, it is a so-called squirrel cage, and this is rotated in unison with the article to be tested. This cage (Fig. 2) consists of two or more circular discs, carrying an even number of rods, usually six or eight, arranged slidably in the discs. The rods are accurately made and their common weight is known; therefore, any displacement of one of the rods with respect to the one directly opposite will not affect the static balance, originally perfect, of the cage, but will introduce a certain centrifugal couple, according to the relative displacement of added distance.

For instance, suppose that the unbalanced body is a special fan, Fig. 3, and that the unbalance is due to two excess weights, grossly exaggerated in the figure. This will result in a centrifugal couple, and to counteract it, the cage will have to be put into a state of unbalance, as shown by the relative displacement of the rods and as measured by the added distance.

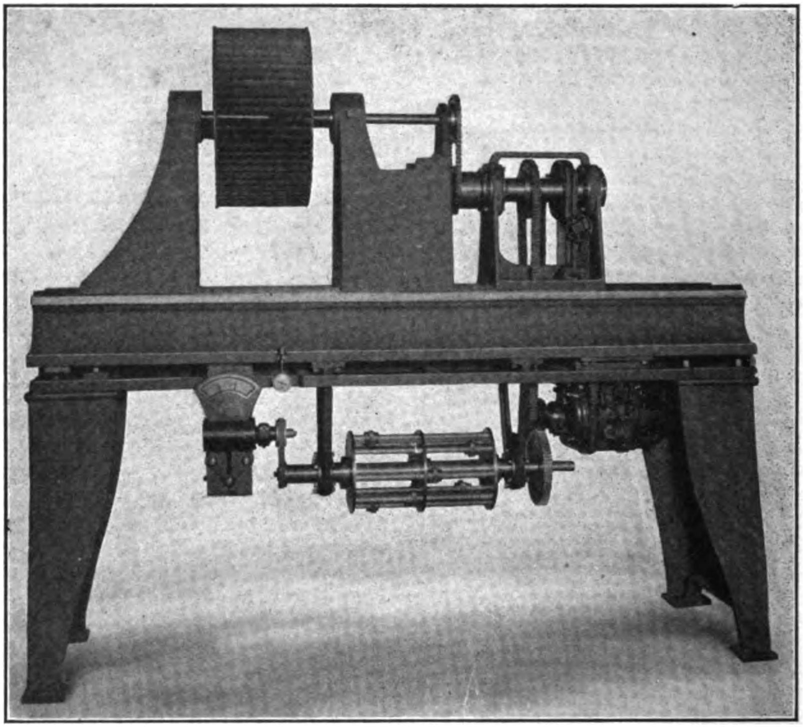

FIG. 3—DYNAMIC BALANCING MACHINE, BALANCING SPECIAL BLOWER.

Thus the cage has means for indicating the exact amount of unbalance which has been put into it in order to reproduce with the opposite sign the exact unbalance of the article being tested. For instance, the displacement or added distance of 15-16 in. may represent (for a certain speed,) a couple of, say, 120 oz-in. The plane of unbalance is easily established by the location of the two rods, the moving of which into a new position stops the vibrations; and the value of the couple is immediately given by the added distance.

It should be clearly understood that the centrifugal couple due to the body acts upon the beam in a simple harmonic manner, that is, according to the law of sines; but so does the effect of the balancing cage. In other words, when the axial plane of unbalance is vertical, the effect of unbalance on the hinged beam is the greatest, as also is the effect of the correcting element, the cage.

When the plane of unbalance is horizontal, that of the correcting element is likewise horizontal, since the cage and the body rotate in unison, and neither is in any manner felt by the beam which does not respond visibly to any but vertical efforts or the vertical components of other couples.

So far as the spring (Fig. 1) is concerned, its object is to intensify the amplitude of the vibrations, although an unbalanced body will always cause the whole bed to vibrate with a frequency corresponding to the speed of the body.

However, there is an additional advantage in the use of the spring, as it is always possible to select the characteristics of this so that, under its load, its free period of oscillation will correspond exactly to the rate at which it is desired to run the test.

Such a synchronism has a large magnifying effect, so that even a slight unbalance results in a considerable amplitude of oscillation.

Public Service Commission Rulings on Central Station Heating

Recent Commission Rulings As to Heating Service.

The Idaho Commission in re Great Shoshone & T. F. Water Power Co. Case No. 112, Order No. 269, August 26, 1915, approved a form of application for and rules and regulations governing electric air heating service.

In the Cleveland Electric Illuminating Co., No. 603, September 29, 1915, the Ohio Commission found that certain additions and extensions to the distributing plant of a light, heat and power company required by the ordinance of a city were reasonable and necessary to the interest of the public, and should be made, and ordered that the company make such additions and extensions to its distributing plant as might be necessary to furnish a new city building with an adequate supply of heat, upon condition that the city obligate itself to accept and use the service for a period of not less than ten years.

The Wisconsin Commission holds that a public service corporation will not be allowed to discontinue heating service to certain patrons on the theory that topographical conditions render it impossible for the company to furnish such service where it appears that satisfactory service was formerly rendered and that the company is about to enlarge certain of its mains which may result in materially improving the service on the lines in question; but if experience should demonstrate that, with increased main capacity, it is impracticable to render adequate service on any part of the system, the matter will be fully considered upon petition. La Crosse vs. Wisconsin-Minnesota Light & Power Co. The company was required to pay for changing from a pneumatic to a hydraulic system of heating regulation in cases where the owner had already paid for the penumatic installation.

It was also held in that case that a company supplying heat to its customers should have the right to determine the amount of square feet of radiating service, the size of the supply pipes, the location of radiators and piles and, in general, should either install all service or approve plans when the work of installation is performed, by other persons. Valves connecting mains with service installations should be under the control of the company, and kept locked by it.

Commission Rulings as to Heating Rates.

The following orders relating to heating rates have been recently made by the Indiana Public Utilities Commission:

In re Central Heating Company, No. 1770, Sept. 24, 1915, the commission approved a flat heating rate of 14.60 cents per square foot of required radiation for heating season of seven months for office buildings of specified steel and concrete construction, having specified heating equipment and subject to various regulations.

Re Interstate Pub. Service Co., Nos. 1820, 1821, Oct. 7, 1915. An order was made permitting the words "except that all radiation installed by the consumer in addition to that required by the formula will be charged for," to be stricken from the rules of the company governing heating service in the towns of Lebanon and Fowler.

Jurisdiction Over Steam-Heating Companies.

Steam heating appears to have been withheld from the jurisdiction of the Colorado Commission under the public utilities law of that state, and for this reason the Commission holds that it is without power to adjust the rates of the steam-heating department of a utility. The statute enumerates all the utilities which shall be under the jurisdiction of the Commission, and steam heating is not named among them.—Re Colorado Springs Light, Heat & Power Co.

Increase of Rates for Hot Water Heating Service.

On petition for authority to increase rates for hot water heating service in the city of Peru, Indiana, an order of the Commission authorized an increase of rates from 20 cents to 25 cents per square foot of radiation on the basis of an installation of 91,500 sq. ft. This action was taken after the Commission found that the valuation of the plant and intangible properties was $50,000, and the operating expenses and taxes, $17,800. The Commission also directed the company to set aside a depreciation fund of 2 per cent. annually, on the value of its plant and intangible properties until the further order of the Commission.—In re Peru Heating Co.

Rate of Depreciation—Hot Water Heating.

In fixing the rates for hot water heating service, the Indiana Commission holds that an allowance of 3% on the total valuation of the utility for straight line depreciation and 2% on the sinking fund basis was reasonable where it appeared that the life of the distribution system was estimated at twenty-five years, the plant equipment estimated to be in 50% condition after thirteen years' use, and the buildings estimated at 90% condition.—Re Peru Heating Co.

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New Rate System for Central Station Steam Service.

A new system of charging for steam heating service has been established by the Rochester Railway and Light Co., Rochester, N. Y. It is described by R. D. DeWolf, of this company, who designed it, as a base steam rate system, on which all gross steam bills are figured. This is essentially a step-by-step rate, varying from a consumption of 5,000 lbs. per month up to over 2,000,000 lbs. per month. The form of this rate is published in the Bulletin of the National District Heating Association for October and is as follows:

First 50,000 lbs. per month @ A c. per 1,0000 lbs. per month.

Next 50,000 lbs. per month @ B c. per 1,000 lbs. per month.

Next 200,000 lbs. per month @ C c. per 1,000 lbs. per month.

Next 1,700,000 lbs. per month @ D c. per 1,000 lbs. per month.

All over 2,000,00 lbs. per month @ E c. per 1,000 lbs. per month.

It is evident that for any given consumption per month, the gross steam bill can easily be determined.

Any steam customer who is also an electrical customer will be allowed a rate reduction depending upon the kw. hr. used by the customer. For each kw. hr. used, fifty pounds of steam will be allowed at the rate shown in the reduction table, up to and including the total amount of estimated or metered low pressure steam. The total amount of reduction allowed for the total steam equivalent to fifty times the kw. hr., will then be deducted from the gross steam bill, leaving the net amount due the company.

The reduction table is as follows:

First 1,000,000 lbs. per month @ F c. per 1,000 lbs.

All over 1,000,000 lbs. per month @ G c. per 1,000 lbs.

For the sake of illustration, assume that the customer uses 500,000 lbs. of steam in a given month and 2,000 kw. hr. His bill would then be made up as follows:

50,000 x A =.................. ....
50,000 x B =.................. ....
200,000 x C =.................. ....
200,000 x D =.................. ....

Gross steam bill.................. ....
Reduction = 2,000 x 50 x F =.... ....

Net steam bill.............. ....

The above rate system is, of course, an approximation. No attempt has been made to include the maximum demand factor in this. As the art develops, means of measuring such a maximum demand may be developed to meet conditions, but at present the difficulties involved in getting such data on a commercial scale are prohibitive. This rate is, however, an attempt to correlate the steam and electrical demands of the customer and give him the advantage of such correlation. The unit prices have not been given in the above tables, as they are so largely dependent upon local conditions and might be very misleading.

NATIONAL DISTRICT HEATING ASSOCIATION

Plans for 1917 Convention.

The mid-year session of the executive committee of the National District Heating Association was held at the office of Secretary D. L. Gaskill, in Greenville, O., October 27-28. The committee favored Detroit, Mich., as the place for holding the 1917 convention and tentatively selected three days in June as the time. The committee also outlined the plans for that meeting. Owing to the quantity of matter which will be on hand, including reports of the standing committees, it is probable that a four-day convention will be necessary to adequately handle the subjects.

Meeting of Research Committee.

The research committee, apointed to work in conjunction with a similar committee from the New England section of the National Electric Light Association, met at Niagara Falls, August 25, and its report will be presented at the next meeting of the National District Heating Association. The district heating association was represented by D. S. Boyden, Boston; George W. Martin, New York; S. Morgan Bushnell, Chicago; and R. D. DeWolf, Rochester, N. Y.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New Officers Nominated.

The following nominations have been made by the nominating committee of the society, the election being by mail ballot and the result announced at the annual meeting in January:

For president, J. Irvine Lyle, New York.

For first vice-president, Arthur K. Ohmes, New York.

For second vice-president, Fred. R. Still, Detroit, Mich.

For treasurer, Homer Addams, New York.

For members of the council: Davis S. Boyden, Boston, Mass.; Bert C. Davis, Newark, N. J.; M. W. Franklin, Bloomfield, N. J.; Charles A. Fuller, New York; H. M. Hart, Chicago; Dr. E. Vernon Hill, Chicago; J. M. Stannard, Chicago; and Walter S. Timmis, New York.

New York Chapter.

New York heating engineers started their fall activities with a meeting of the New York Chapter, October 16, in the rooms of the Building Trades Club. The meeting was a get-together dinner, and was followed by a stereopticon lecture on "Spots of Revolutionary History," by Frank K. Chew. Before Mr. Chew was introduced, President Arthur Ritter, of the chapter, drew attention to the program which had been prepared for the winter and then called on M. W. Franklin, who urged that the members make a concerted effort to arouse the interest of all connected with the heating trade in the coming chapter meetings.

The chapter programme contains the announcement that Secretary C. W. Obert, of The American Society of Heating and Ventilating Engineers, has volunteered to assist in the secretarial work of the chapter.

The succeeding meetings will be in the hands of special committees, made up of eleven members each, with the exception of the January meeting, which will be merged with that of the annual meeting of the society.

The chairman for the November meeting is A.. M. Feldman; December, Homer Addams; February, J. Irvine Lyle; March, D. D. Kimball; April, Dr. M. W. Franklin; May, George W. Martin.

For the November meeting, which will be held at the Employers' Trades Club, 31 West 31st street, New York, November 20, a treat is promised in the form of a lecture on a new type of vacuum steam heating system. This system, it is stated, operates without air valves on the radiators and without traps on the return lines. It will be described by the inventor, Charles A. Ball, of New York. Special efforts are being made to secure a large attendance at this meeting, as it is believed data will be presented, not only by the speaker of the evening, but in the ensuing discussion, that will be well worth obtaining.

Illinois Chapter Elects Officers.

New officers were elected as follows at the annual meeting of the Illinois Chapter, which was held October 9, at the Morrison Hotel, Chicago: President, Fred. Powers; vice-president, Dr. E. Vernon Hill; secretary, A. E. Stacey; treasurer, August Kehm. Board of Governors: E. L. Hogan, J. F. Tuttle and G. W. Hubbard.

A report of the auditing committee showed a balance on hand of $183.66. A letter was read from Secretary Obert, of the heating engineers' society, proposing an exchange of papers between the chapters.

A number of suggestions was made for topics of discussion at future meetings, such as hot water vs. vapor heating, air movement through inlet registers, and descriptions and installations such as those in the C. B. & Q. Building, in Chicago and in the Real Estate Trust Building, in Philadelphia.

The following new members were elected: J. Cutler, J. C. Hornung, Lloyd Howell, J. G. Keleher, F. Lautenschlager, C. T. Morse and F. P. Keeney (associate).

Massachusetts Chapter.

The November meeting of the Massachusetts Chapter will be held at the City Club, Boston, November 14, when an address will be given by William C. McTarnaham, vice-president and manager of the Fess Rotary Oil Burner & Liquid Fuel Co., of Providence, R. I., on "Oil as Fuel, Its Uses, Its Various Methods of Application, Etc."

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Autumn Meeting of British Heating Engineers.

A paper on "The Coefficients of Heat Transmission Established by the Austrian Engineers," by Alcwyn A. Jones, was the principal item on the programme for the autumn meeting of the Institution of Heating and Ventilating Engineers, which was held at the Holborn Restaurant, London, October 10, 1916.

NATIONAL ASSOCIATION of MASTER STEAM AND HOT WATER FITTERS

Master Steam Fitters Favor Arbitration in Labor Disputes.

In connection with the recent dispute between the railroad workers and their employers which was settled by the passage of the so-called Adamson "eight-hour law," the National Association of Master Steam and Hot Water Fitters went on record, through its board of directors, as favoring arbitration in the settlement of the dispute. In a telegram dated August 26, 1916, before the passage of the new "eight-hour law," the directors sent the following telegram to President Wilson:

"We strongly urge that the present dispute between the brotherhoods and railroads be settled only by arbitration. Newspaper reports would indicate that the enforcement of the so-called eight-hour day as demanded by the brotherhoods will result solely in an increase of about 25% in their daily rate of wage. It seems absolutely unjust that such a demand entailing an expense of many millions of dollars should be forced on the railroads without the question being referred to arbitration. Submission by the railroads would unquestionably result in a similar demand by all the other employees of the railroads with a perfect right to anticipate a similar forced settlement.

"If the brotherhoods are sincere in their demand for an eight-hour day why should they not accept the principle of such a day at the same hourly rate of wage as at present and leave to arbitration whether they should receive for that shorter day the same wage as for the longer day? We feel that the settlement of this question without arbitration will injuriously affect the relations of workmen and employers throughout the entire country."

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Area of Cylindrical Pipes or Ducts.

Here is a chart that will be found handy for determining the radiating surface of all kinds and sizes of pipe; the heating surface of boilers, tubes, superheater flues and condenser tubes; the square feet of surface of refrigerating coils; and the square feet of metal needed for circular ventilating and heating ducts.

In fact, wherever it is desired to find the area of a cylindrical structure of the shape of a common pipe, this chart will give the answer quickly and accurately.

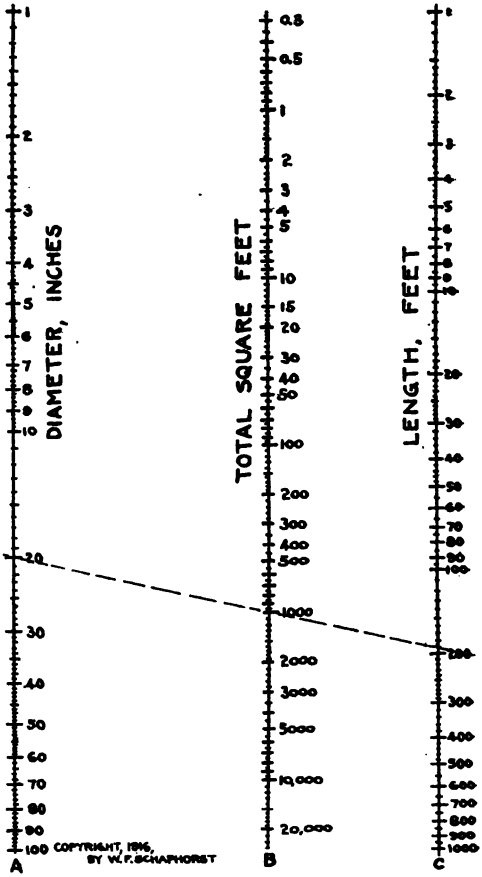


CHART FOR DETERMINING AREAS OF CYLINDRICAL PIPES FOR DUCTS.

As will be noted, the range of the chart is very wide, from 1-in. to 100-in. diameter measurement, and from 1 to 1,000 ft. lineal measurement. The dotted line drawn across the chart, for example, shows that where the diameter is 20 in. and the length 191 ft., the total area is 1,000 sq. ft.

The chart may also be used "backwards" to advantage. For example, if any figure in column C is known, and the total radiating area in column B is known, a straight line through the two poins will give the correct diameter in column A.—W. F. Schaphorst, M. E.

◆

National Founders' Association will hold its twentieth annual meeting in New York, November 15-16, 1916, with headquarters at the Hotel Astor. The convention banquet will be held Wednesday evening, November 15.

The Smokeless Boiler Number.

Editor HEATING AND VENTILATING MAGAZINE:

You are certainly to be congratuated on the educational value of your October smokeless boiler number as regards the direction that the heating boiler is drifting, faster even than the smokeless boiler manufacturers themselves perceive.

The average heating boiler has been so wasteful, approximating under 50% rather than over 50% efficiency, which is becoming apparent to owners by comparison, that the manufacturers absolutely have got to make changes in their apparati, by adapting boilers to cheaper fuel, making furnaces and flues so that the combustion can be better and last, but most important, making grates less wasteful and more fool-proof, because at this point in most heating apparatus is where a tremendous waste into the ashpit is going on continually.

It is my opinion that in ten years from now you will be very well satisfied with what you added at this time to the trade literature on smokeless boilers.

HOMER ADDAMS.

New York, October, 1916.

Figuring Duct and Flue Sizes.

Editor HEATING AND VENTILATING MAGAZINE:

In THE HEATING AND VENTILATING MAGAZINE for October there is an article entitled "Comparison of Various Methods of Figuring Duct and Flue Sizes." The article is readily comprehensible to me, with the exception of a portion of the table at the top of page 34.

I can follow this table with the exception of the last two columns, or, rather, either of the last two coumns. I do not see how the actual duct area or duct size was derived from the equivalent number of 1-in. pipes. I can see, of course, and understand that the various ducts are not directly proportional to the equivalent number of 1-in. pipes, and if you would give me the necessary formula for use in this casee, or the usual method of computation, I should be much obliged.

P. A. L. F.

Portland, Me.

REPLY BY HAROLD L. ALT.

The two columns referred to cover the size of duct and the area in square inches when the equivalent number of 1-in. pipes (as shown in the preceding column) is known. The last column is, of course, only a multiplication of the duct dimensions given and what our correspondent evidently wants to know is how the equivalent numer of 1-in. pipes is transposed into a duct size.

This is done by means of a table of equivalent numbers of 1-in. pipes which is commonly termed an "equalization table." This table applies either to round or square ducts, the diameter of the round duct or the side of a square duct being used as a basis. In principle the idea is that a certain amount of air passing through a 1-in. square, or round, pipe, at a certain velocity, will produce a given friction per unit of travel. Now twice this quantity of air passing through a duct equal to two 1 in. pipes will not produce a similar friction loss per unit of travel, owing to the lesser amount of skin friction; therefore, to produce the same friction loss per unit of travel the velocity must be increased until the friction reaches the original amount. The formula on which this is based is

$$N \text{ equals } \sqrt{\left(\frac{A}{b}\right)^5}$$

When A equals the diameter of the round (or the side of a square) duct.

b equals the diameter of the round (or the side of a square) but smaller duct.

N equals the number of smaller pipes of equal carrying capacity.

A very complete table worked out from this formula is given in "Trautwine's Pocketbook" under the "Square Roots of Fifth Powers." Part of the table is given herewith:

Large Duct.	Equivalent 1-In. Pipes.	Large Duct.	Equivalent 1-In. Pipes.
1	1	14	733
2	5	15	871
3	15	18	1374
4	32	20	1788
5	60	24	2821
6	88	30	4929
7	129	36	7776
8	181	42	11432
9	243	48	15963
10	316	54	21428
11	401	60	27886
12	498	66	35388
13	609	72	43988

It must be understood that in using this table either square or round pipes may be used, provided that the computation is carried all the way through as square pipes or as round pipes, but they are not interchangeable in the same calculations. If, however, a change is desired in the sectional shape as, for example, in a duct system sized on the basis of round pipes where it may be required to transform to a square section, the diameter of the round pipe will be 10% in excess of the side of a corresponding square pipe and the diameter for a round pipe is computed and then divided by 1.10 to obtain the side of the equivalent square duct.

Similarly, in a system sized on a basis of square pipes, a change to round form can be made by computing the side of the square duct and then multiplying by 1.1 to get the diameter of an equivalent round duct.

Theory of the Brasher Air Breakwater.

A peculiar phenomenon illustrated by the Brasher air breakwater has been called afresh to the attention of engineers by a correspondent of The Engineer, of London, who writes in that journal:

"As the propagation of waves has been of some interest and study to me I would like to suggest that the theory on which Mr. Brasher has originated his breakwater has a simpler basis than that offered, at least, if my theory of wave action is fairly correct. The theory I put forward is based on certain experiments which I hereinafter describe, as well as on the known effects of air currents on aeronautic planes.

"My theory is that a current of air of suficient velocity, passing over a rounded surface, causes a slight increase of pressure above the atmosphere on the windward side, and a reduction of pressure below atmosphere on the leeward side. As an illustration of this theory, I send a photograph, Fig. 1, of an apparatus, by which it has been demonstrated that a ball or an ordinary 8-in. file can be supported in the air if a jet of air of sufficient velocity is passed over the rounded surface of the ball or the rounded end of the handle of the file. It would appear that the velocity of the jet passing over the rounded surface increases the pressure of the atmosphere slightly on the rounded surface towards the jet and reduces the pressure on the opposite side below that of the atmosphere, so that the file or ball is held up to the jet by the pressure of the atmosphere. That the support afforded by these air pets is of some magnitude is proved by revolving the ball of the apparatus, which, being fed from the source of the air supply through the stem, forms a small reservoir for the jets or nozzles inserted in the ball. When the ball is revolved, which is done by the small air-driven wheel at the bottom of the stand, the articles supported in the air revolve with the jets, and a considerable pull on the end of the file is necessary to detach it from its support on the jet. To obtain the support of the jet the rounded surface of the ball or handle of the file must be approached gently to the lower surface of the jet, and must not enter the jet itself. The above explanation is given in order to illustrate my theory of the action of the wind on the surface of the water shown on the accompanying diagram, Fig. 2, which explains itself. This diagram suggests that waves have a difference of atmospheric pressure on their two sides caused by the velocity of the wind over their rounded crests.

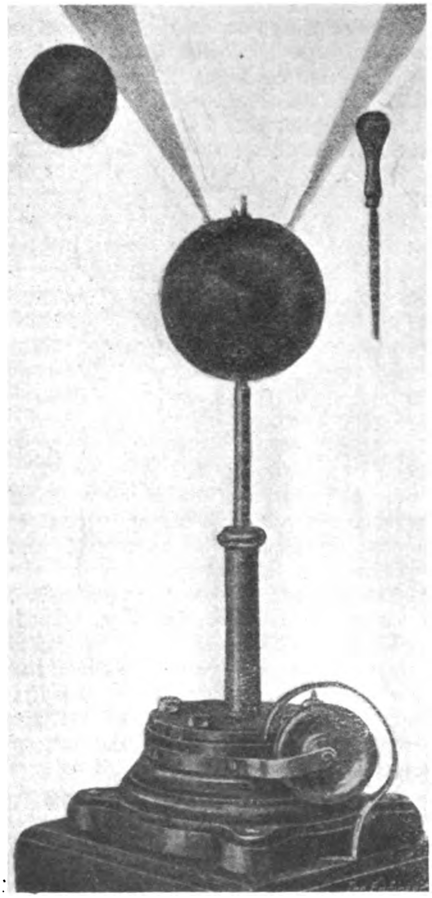


FIG. 1—ILLUSTRATION OF ACTION OF BRASHER AIR BREAKWATER.

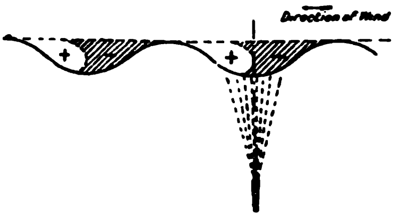


FIG. 2.

"By Mr. Brasher's breakwater this difference of atmospheric pressure caused in the troughs between the waves by the velocity of the wind passing over their crests is neutralized by the admission of air above atmospheric pressure, which is delivered into that space by the jets of the breakwater from below the surface of the water and below the current of air passing over the crests of the waves. In this way the rise and advance of the waves is mechanically checked."

Efficient Heating for Institutional Groups.

By Albert L. Baum.

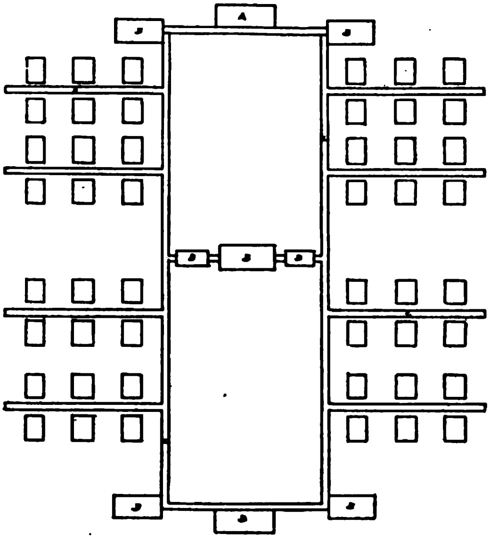
The present tendency in the design of our large institutions leans towards the village idea, i. e., a number of separate dwelling houses, interconnected by pleasant walks and passageways, and a few central buildings for service and administration purposes, the whole so arranged that it usually spreads over a considerable area. Generally speaking, sufficient funds are not at first available for the completion of the entire group of buildings as planned, but provision is usually made in such cases for future extensions and additions.

In serving such a group of buildings with heat, light, water, and power, the general aim is toward the centralization of service. The advantages of such a central plant are so well known, and have been presented so frequently, that I need not review them again. I shall take them for granted, and shall use the central plant as a starting point for this discussion of the type of heating system best adapted to such a group of buildings. It is obviously important that such a heating system be simple, reliable and effective. Good and healthful living conditions are vitally connected with proper heating. An error in the determination of so important a feature is most serious, and likely to result in tremendous expense if a rectification of that error is to be made at a later date.

The central plant having been determined on, the two possibilities as mediums for heating are steam and hot water. In order to more clearly understand the nature of the problem, let us consider a layout such as shown in the diagram, which represents a large institution of the hospital type, with isolated buildings. The distance from the power house to the end of the group is seen to be about 2,500 ft., almost one-half mile, and institutions have been designed, such as Letchworth Village for the Feeble-minded at Thiells, N. Y., where this distance exceeds a mile.

Whether steam or forced hot water is circulated as a means of heating the buildings, some exhaust steam will be available from the engines or turbines of the central generating plant; usually, however, not nearly enough for the full heating load. With a back-pressure on the generating units of not more than 3 or 4 lbs., it is evident that the exhaust steam, even if enough were available, cannot be used for heating the far buildings. These, if steam heated, will have to be served with high-pressure steam, reduced in pressure at the buildings, which will at least permit the use of smaller distributing mains.

Economy demands that the condensed steam be returned to the boilers in the central plant. The facility with which this may be done with steam heat depends largely on the relative levels of the buildings. A gravity return system is by far the cheapest. If this is not possible, a vacuum return line system may sometimes be utilized. But here, again, not only are proper grades essential, but the distance from the last buildings to the central plant must also be considered. A last resort for getting back the heating returns (where relative levels forbid the use of either of the foregoing methods) is the system of pumping, and this means a number of return pumps scattered over the property, which must be provided with power, either steam or electric, and which also demand frequent attention both as to operation and maintenance. Such an arrangement materially decreases the advantages of the central heating plant.



BLOCK PLAN OF INSTITUTION OF HOSPITAL TYPE, WITH ISOLATED PAVILIONS.

A—Central boiler house and power house.
B—Administration and service buildings.
C—Interconnecting passageways for pavilions.
(Distance from boiler plant, A, to farthest building, B, 2,500 ft.)

ADVANTAGES OF HOT WATER.

Hot water as a heating medium, however, is not subject to such great restrictions. The water can be pumped regardless of grade, so long as proper provisions are made for relieving the entrained air from

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*Member of Javos and Baum, consulting engineers, New York.

all high points where it may otherwise accumulate and cause air-binding of the mains. The water is heated in the central plant, easily utilizing (with a medium back-pressure) exhaust steam, which, as steam, could not be made to reach the farthest buildings. In plants of this kind the heating load is usually much larger than the power load. Under such conditions all the exhaust steam available during most of the heating season can be used directly for the hot water heating equipment; furthermore, the water of condensation is immediately regained without the slightest inconvenience. By no other distributing system can the heat be distributed with such little difficulty.

It is at once evident what a great advantage is effected by the central control of the hot water heating system. The operating engineer can at all times watch the temperature of the outgoing water, and vary it to suit varying weather conditions. During very severe weather the water may readily be heated as high as 200° F. (or even a little higher), thus giving out a large quantity of heat from the radiators and stacks in the buildings. As the weather becomes milder, the water temperature is reduced accordingly, thus cutting down the amount of heat supplied to each room in proportion to the decreased demands of the outside weather conditions.

With steam heat, overheating of the rooms is almost unavoidable, since the steam temperature in the radiators is nearly constant, regardless of weather conditions. The method usually followed in practice to avoid overheating in mild weather when a little heat is still required is to open the windows; this means, in effect, dumping out of the windows the equivalent of a large part of the coal consumed. One method of saving much of this waste is to use thermostatic control in all of the scattered buildings; but thermostats are delicate instruments, and are also expensive, both to install and to operate. Tampering with them does them no good, and, where it is desired to make simplicity the keynote of design and operation, delicate instruments, scattered all over the buildings, should be avoided. Another method of effecting coal economy is the use of a vacuum-return or open-return line system, with fractional steam control, and automatic return valves on the radiators. But the necessary appliances are expensive to install, involve care and maintenance, and require the frequent manipulation of hand valves all over the institution.

The hot water heating system, on the other hand, by its variation of water temperature avoids the need of thermostatic or other scattered means for controlling the temperature of the rooms. It therefore eliminates from the buildings all mechanical devices, with the exception of one or two automatic air traps in each building and a hand valve (which need rarely be touched) on each radiator. By means of this central control, and its ability at all times to avoid overheating the buildings, the forced hot water heating system secures the maximum of fuel economy with the minimum of mechanical elaboration and of attendance.

Besides avoiding the loss due to overheating of the rooms, as just explained, the hot water system has considerably smaller radiation losses from the distribuing mains than any of the steam systems. With the forced hot water system the maximum losses from this cause occur in the coldest weather, when the maximum water temperature is carried. As the weather becomes milder, the water temperature is lowered, and this in turn decreases the radiation losses from the mains. Steam, however, does not recognize changes in the weather. Whether the rooms are controlled by thermostats or by hand, or by open windows, the heating mains carry the steam continuously at a high temperature, since the temperature and pressure of steam are related by physical laws beyond the control of man. Hence the radiation losses, instead of becoming materially less in mild weather, as is the case with hot water, remain fairly constant throughout the heating season. The excess of these losses in the steam plant over those in the hot water plant for the same particular group of buildings may easily amount to several hundred tons of coal per year, depending on the size of the institution and the distance apart of the buildings.

The foregoing considerations have been presented from the point of view of operating costs. Coincident with operation are the costs of maintenance. The greatest part by far of the heating equipment of a large group of buildings on a widely extended area is the piping connecting all the heating surfaces with the source of heat in the central plant. In the steam heating system his entire network of piping carries during the heating season a mixture of steam, air and moisture, while during the summer it remains dry and empty. With the forced hot water heating system the piping can remain at all times filled with water, from which practically all dissolved air has been expelled. It has long been known that piping does not rust out nearly as rapidly while it remains filled with such water as when in contact alternately with air and moisture. This gives the hot water system the advantage of much longer life, and longer life means a cheaper maintenance and depreciation charge, as well as less trouble from repairs.

There is still another phase of this question which, from a physician's point of view, should be important—namely, the health aspect of heating systems. Investigations have shown that particles of dust (largely organic matter) carried in the air begin to "burn" or decompose at about 165° F., and, since the temperature of the steam-heated radiator is always much higher than 165° F., it is at once evident what is taking place in a hospital ward heated by such radiators. The consistently lower temperature of the hot water radiators avoids in almost all cases this irritating annoyance from decomposing dust. It therefore secures a heating effect which is at once the more healthful of the two possibilities, and also affords a much more even temperature in the rooms due to the much lower intensity of radiation from the lower temperature radiators.

The only statement that can be made against a forced hot water system in favor of a steam heating plant for a group of buildings as herein shown is a possible slightly increased first cost of the hot water system. As opposed to this, however, are (1) the advantages of central control of the heat, (2) the simplicity of installation and operation, (3) the economy effected by avoiding overheating of buildings, (4) the economy effected by decreased radiation from the heating mains, (5) the longer life of the heating equipment, and (6) the more healthful character and more even distribution of the heat in the rooms, all of which go very far toward making forced hot water the ideal heating medium in a plant which proposes to be an effective and economic investment for the community as owner.—From the Modern Hospital.

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Current Heating and Ventilating Literature.

(Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from The Heating and Ventilating Magazine *on receipt of the stated price.)*

ELECTRIC HEATING—

Experience with Electric Heating of Dwellings. J. D. Ross. Ills. 2500 w. El W—Aug. 26, 1916. System tried at Seattle. 20c.

New Publications.

How to Build Up Furnace Efficiency, by Joseph W. Hays (tenth edition), described as a handbook of fuel economy, is a book of 154 pages, and about as breezy a treatment of the subject as one could wish to find. Special pains have been taken to eliminate, as far as possible, a strictly technical discussion of the various points involved and the author "gets down to brass tacks" wherever possible. That Mr. Hays' popular treatment of the subject is appreciated may be judged from the statement that the book is now in its fiftieth thousand. One of the features of the new edition is the appearance of numerous charts, diagrams and other illustrations which supplement the text. Mr. Hays makes the flat statement that "any man who can read a scale and watch the flickering flame of a tallow candle is qualified to bring any boiler furnace up to the highest state of efficiency consistent with the fuel and the furnace equipment." Proceeding on this basis he takes up why, how and where fuel is wasted in the boiler room, many of his points being aptly turned by illustrative anecdotes. The narrative style is followed throughout. Size 5x7¼ in. Pp. 154 and index. Price $1.00 postpaid. Published by Jos. W. Hays, Rogers Park, Chicago, Ill., or may be had through the book department of The Heating and Ventilating Magazine.

Bulletin of the National District Heating Association for October, 1916, the quarterly publication of that association, contains as its leading article a description of the problems of underground piping in New York City, by Charles N. Green, one of the engineers for the New York Public Service Commission. The article takes up the tangled conditions of piping of all kinds in New York's streets, together with the complications that arose in connection with the building of the new subway extensions. He urged municipal regulation in the construction of all such work, suggesting that locations should be assigned for all subsurface structures in new streets and where possible in old streets. Another solution of the problem is the revoking of vault privileges and the use of sidewalks, as well as roadways, for the accommodation of public utilities. The association's "Question Box" contains some twenty questions and answers. One of the interesting questions was, "How much per 1,000 cu. ft. does it cost to wash air?" H. Carrier, of Chicago, answered this question by stating that the cost will vary widely on account of the varying cost of power in different localities and whether it is purchased or manufactured. Another variable item is the size of the unit, the smaller the unit, the greater the proportionat cost. The following estimate is then given, based on a washer of about 25,000 cu. ft. per minute capacity, with power at 2 cents per horse power at the apparatus. It is assumed that the plant will be operated 3,000 hrs. a year. The annual cost per 1,000 cu. ft. per minute delivered for 3,000 hrs. will be about as follows:

Interest and depreciation per year..	$3.00
Care and repairs....................	2.00
Cost of extra horse power to drive ventilating fan 1 H. P. x 3,000 x $0.02	6.00
Cost of horse power to drive pump 0.15 H. P. x 3,000 x $0.02..........	9.00
Total cost per year per 1,000 cu. ft. of air per min. washed............	$20.00

This will be a total cost of washing 180,000,000 cu. ft. in one year or a cost of $0.11 for each 1,000,000 cu. ft. washed. The horse power for moving the air and for operating the spray pump is taken from actual tests on the resistance of the washer, the efficiency of the fan, and the horse power input into the pump motor. Interest and depreciation is figured at 15% of the average plant cost.

Journal of The American Society of Heating and Ventilating Engineers for October, 1916, contains, among other things three papers to be presented at the forthcoming annual meeting of the society in January. These are "Remodeling the Ventilation of a Theatre," by S. R. Lewis; "Windows," by Dr. E. V. Hill; and "Railway Passenger Car Heating," by E. W. Rietz. The proceedings of the midsummer meeting in Detroit are published in this number, together with the discussions. Announcement is made that Volume 22 of the Transactions for 1916 (Volume 22) will soon go to press.

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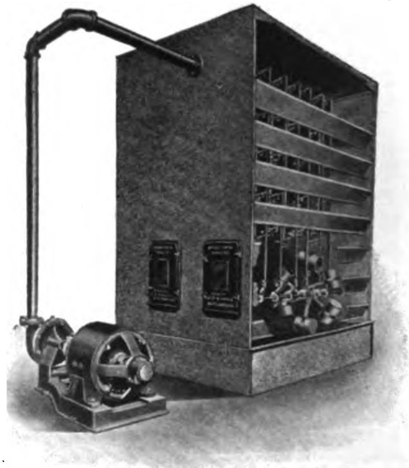
Trade Literature.

Kewanee Firebox Boilers, for steam and water heating, including brickset and portable types, are discussed in the company's catalogue No. 68, issued by the Kewanee Boiler Co., Kewanee, Ill. The catalogue is handsomely compiled, and includes numerous large sectional views, in half-tone, of both the brickset and portable types. Complete specifications and price lists for each type are also given. Size 6 x 9 in. (standard). Pp. 32.

Molby Down-Draft Boilers are featured in catalogue matter sent out from the new address of the Molby Boiler Co., Inc., 101 Park avenue, New York. The company states that it has completed an entirely new equipment for the manufacture of these boilers, including patterns, flasks and shop equipment and is prepared to turn out boilers promptly, with every detail carefully worked out. Molby boilers are made in three series each, for steam and water. The steam series are 26 in. (six sizes ranging from 750 to 2,000 sq. ft. radiation); 31 in. (seven sizes ranging from 1,800 to 4.500 sq. ft.) and 47 in. (eight sizes ranging from 3,000 to 8,250 sq. ft). The water series are 26 in. (six sizes ranging from 1,250 to 3,350 sq. ft. of radiation), 31 in. (seven sizes ranging from 3,000 to 7,500 sq. ft), and 47 in. (eight sizes ranging from 5,000 to 13,750 sq. ft.).

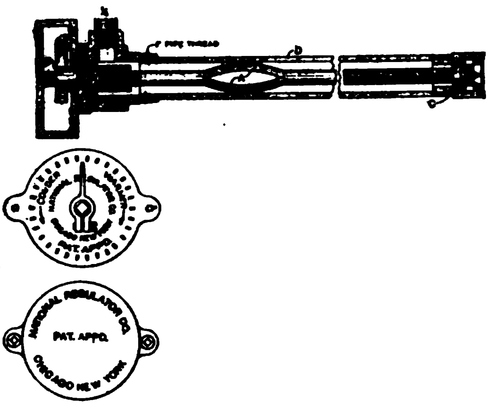
The Midwinter Morning Scream (not a movie) is the title of what is described as a "thrilling farce melodrama in three screeches." passed by "the National Board of Goodsensorship" and published by the Bishop-Babcock-Becker Co., Cleveland, O. A study of the plot discloses the information that it has to do with the experiences of tenants in a cold office building, their remedy for their troubles and the comforts enjoyed when the remedy was applied. Needless to say, the remedy was the installation of a Bishop-Babcock-Becker "Reliable" vacuum steam heating system.

Bicalky Air Washers are discussed in recently-issued circular matter received from the Bicalky Fan Co., Buffalo, N. Y., calling attention to the details of construction of this type. The automatic flushing feature is gone into at length. A rigid shaft is placed across the air washer above the sump. This runs freely and is rotated by means of buckets filled with falling waste water from the spray heads. Cams are arranged on this shaft under each vertical row of spray heads so as to operate a series of tee iron rods connected with the different rows of heads. When released by the cams these rods fall, and produce a hammer blow on the center rods of the spray heads, causing a rush of water through the nozzles, which dislodges any dirt



BICALKY AIR WASHER, SHOWING AUTOMATIC FLUSHING DEVICE.

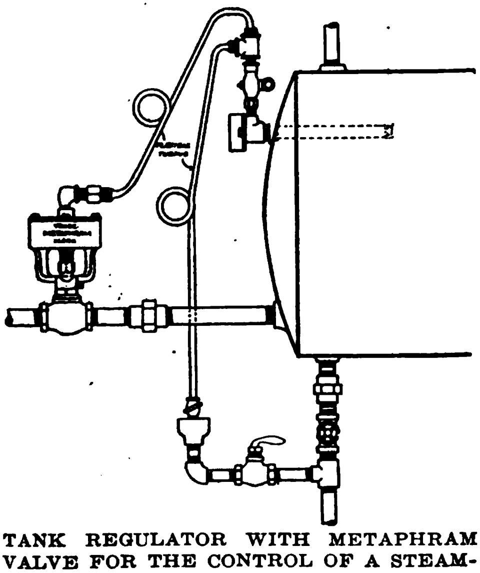
which may have accumulated in hindrance to a perfect mist spray. The cams are set so as to drop one tee at a time, which in turn flushes this verticle row of spray heads. This operation continues alternately. Emphasis is laid on the point that the mist from the spray heads remains intact while flushing. This, it is added, is of the greatest importance for the reason that it offers no weak spot in the mist sheets during the flushing operations to permit any of the foreign matter passing through the air washer. The circular also shows and describes the spray heads and eliminator plates used with the Bicalky air washer, as well as the strainer, door and spray chamber.



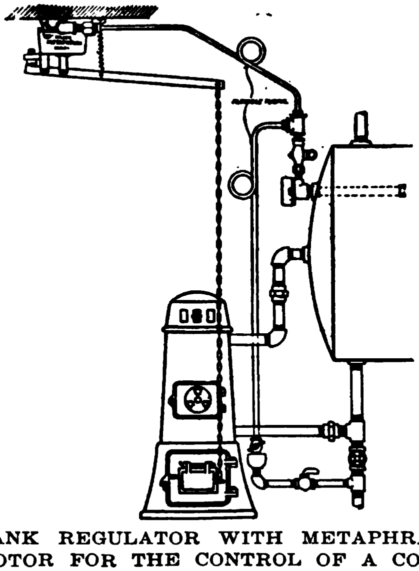
CONSTRUCTION OF NATIONAL TANK REGULATOR.

National Tank Regulators and their operation when equipped with Metaphram valves are featured in newly-issued circular matter received from the National Regulator Co., Chicago. As regards the regulator itself, the stem, D, is provided with a 1-in. pipe thread, inserted into the tank and subjected to the water under pressure. When the temperature of the water rises, element A, being highly sensitive, expands, and the valve C attached to the end of the element is thrust from its seat, allowing the water under pressure to rush through the stem of the regulator and thence to the diaphragm motor or valve, whichever the case may be, closing off the heat source. When the temperature of the water falls, the element A contracts quickly and pulls the valve C to its seat, preventing further flow. Consequently the motor or valve will expel its pressure through the waste and thus open the heat source. The Metaphram hydraulic tank regulators are graduated in action, which, it is stated, is a trait peculiar to National thermostats, making them sensitive to quick temperature changes, affording close regulation, and increasing fuel economy. These regulators are self-contained so that they are dust-proof and are all metal. They are furnished complete with a 12-ft. length flexible tubing.

Reliable Evidence is the title of an impressive installation book published by the Bishop-Babcock-Becker Co., Cleveland, O., listing 879 prominent buildings, of which 146 are illustrated, all equipped with Reliable vacu-vapor vacuum and vacu-vapor heating systems. The various installations are grouped and classified according to types of buildings and geographical location. Endorsements from owners are presented in the form of foot-notes, the whole comprising, as the company states, "reliable evidence" as to the quality and versatility of Reliable equipment. These points



TANK REGULATOR WITH METAPHRAM VALVE FOR THE CONTROL OF A STEAM-HEATED TANK.

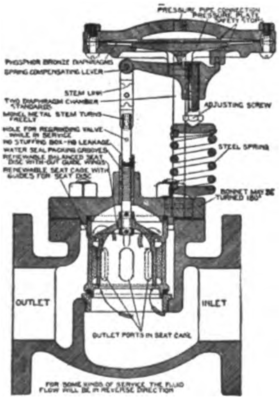


TANK REGULATOR WITH METAPHRAM MOTOR FOR THE CONTROL OF A COAL HEATER.

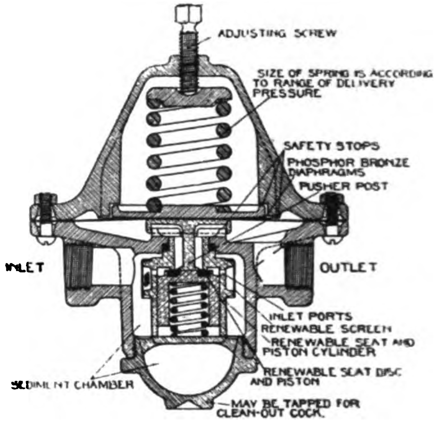
are emphasized by the fact that the installations include remodeled, as well as new, plants while the sizes and styles of buildings range from the skyscraper to the bungalow. The closing pages are devoted to the devices composing the Reliable systems, including the VacUstat, the vacu-trap, the vacu-graduate packless radiator valve, and the Reliable vacuum pump. Size 8x10¾ in. (bound in boards). Pp. 48.

Modified Squirrel Cage Fans, Massachusetts multiblade type, is the title of Bulletin No. 1 of a new series of engineering bulletins being published by the Consolidated Engineering Co., Chicago, Ill. The bulletin is intelligently prepared for the use of the engineer. All superfluous matter is eliminated and the text confined strictly to engineering data. One page is devoted to standard arrangements and discharges of the Modified Squirrel Cage Fan for ten different arrangements. On the opposite page is presented a table of weights of fans for these arrangements. The remaining pages of the catalogue are given over to data tables for single-width, single-inlet Modified Squirrel Cage fans, covering full-housed bottom horizontal discharge, full housed top horizontal discharge, full-housed top vertical discharge and ⅞-housed bottom horizontal discharge. Size 8½x11 in. (standard). Pp. 32.

Cash Standard Reducing and Regulating Valves, Class C, Class E and Class D, are the subject of well prepared circular matter received from the A. W. Cash Co., Decatur, Ill. The Class C valve is of the outside diaphragm and compensating lever type, with balanced double seat, and is for service on high and low pressure steam for power and heating purposes, pump and air compressor governors, etc. Class E valve is for service where the initial pressure is not greater than 40 lbs. and the delivery pressure not greater than 5 lbs. It is especially useful for low pressure district steam heating. The Class D valve is of the diaphragm type and has single, renewable valve seat and seat discs. It is designed for service on cold water, hot water, steam, air, oil and gas lines, being made for water or air with an initial pressure as high as 200 lbs. and for steam with an initial pressure as high as 150 lbs. and delivery pressure not higher than 100 lbs. Valves of this type are also made for heavier service.


PRESSURE PIPE CONNECTION
PRESSURE PLATE
SAFETY STOP
PHOSPHOR BRONZE DIAPHRAGMS
SPRING COMPENSATING LEVER
STEM LINK
TWO DIAPHRAGM CHAMBER STANDARDS
MONEL METAL STEM TURNS FREELY
HOLE FOR REGRINDING VALVE WHILE IN SERVICE
NO STUFFING BOX—NO LEAKAGE
WATER SEAL PACKING GROOVES
RENEWABLE BALANCED SEAT DISC WITH-OUT GUIDE WINGS
RENEWABLE SEAT CAGE WITH GUIDES FOR SEAT DISC
ADJUSTING SCREW
STEEL SPRING
BONNET MAY BE TURNED 180°
OUTLET
INLET
OUTLET PORTS IN SEAT CAGE
FOR SOME KINDS OF SERVICE THE FLUID FLOW WILL BE IN REVERSE DIRECTION

CONSTRUCTION OF CASH CLASS C REGULATOR.


ADJUSTING SCREW
SIZE OF SPRING IS ACCORDING TO RANGE OF DELIVERY PRESSURE
SAFETY STOPS
PHOSPHOR BRONZE DIAPHRAGMS
PUSHER POST
INLET
OUTLET
INLET PORTS
RENEWABLE SCREEN
RENEWABLE SEAT AND PISTON CYLINDER
RENEWABLE SEAT DISC AND PISTON
SEDIMENT CHAMBER
MAY BE TAPPED FOR CLEAN-OUT COCK.

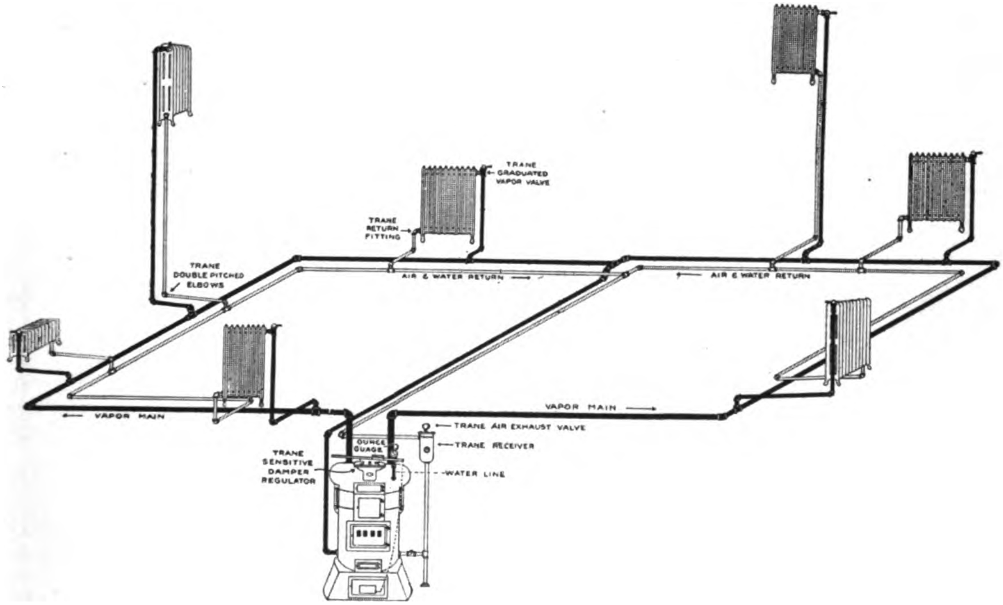
CONSTRUCTION OF CASH CLASS D REGULATOR.

Carrier Air Conditioning and Drying Equipment is treated in a series of unusual engineering bulletins published by the Carrier Engineering Corporation, New York. The latest bulletin (No. 103) discusses the Carrier system of humidifying as applied to textile mills. The bulletin is profusely illustrated with views and plans of typical installations, accompanied by carefully-prepared text on the advantages of the Carrier humidifying system for textile mills, advantages of artificial humidification, conditions affecting humidity, action within the humidifier in summer, and numerous other points. A notable feature of the bulletin is a series of extracts from engineers' reports giving convincing data as to the effectiveness of the installations. Size 6x9 in. (standard). Pp. 54. Bulletin No. 100, previously published, deals generally with Carrier humidifying apparatus, while Bulletin No. 101 covers Carrier dehumidifying apparatus.

Vulcan's Forge, the house organ of the Vulcan Fuel Economy Co., Chicago, announces the change of this firm's name from G. L. Simonds & Co. The company's line includes the Vulcan soot cleaner, Hays gas analysis instruments, Hays differential draft gage, Dean boiler tube cleaner and the Eclipse smoke indicator. The firm was incorporated in 1909 and the new name is adopted to more fully describe ts activtes. The personnel and policies of the organization remain as before. The same issue contains an interesting article on "How Long Will Our Supply of Coal Last?"

Valve World for October, 1916, the monthly periodical of Crane Co., Chicago, discusses "Cast Steel" in its series of non-technical chats, by L. W. Spring, the company's chief metallurgist, which are running in this journal. The article includes illustrations of the first experimental arc electric furnace and of the Snyder electric furnace.

Trane Vapor Heating, described as a simple, noiseless and economical system of vapor heating proven by years of successful operation, is the subject of a new catalogue issued by the Trane Co., La Crosse, Wis. The Trane specialties consist of a vapor regulator, receiver and air-exhaust valve, and ounce pressure gauge for the boiler; also graduated vapor valves, together with special return fittings or thermo traps, for the radiators. In the operation of the system there are preferably two balanced circuts running each way from the boiler, as shown in the illustration by the solid piping which is the vapor main. The air and water return is practically the same length as the supply main. When properly worked out this has the same effect as though each radiator were placed an equal distance from the boiler. Particular care, it is stated, has been given to developing an extremely sensitive and quick-acting vapor regulator. In the Trane system the vapor regulator is connected into the steam dome or into the supply pipe on top of the boiler and chains run from the end of the lever arm to the draft door and to the check draft in the smoke pipe. The pressure in the boiler operates on the body of water in the bottom of the regulator. The Trane special return fitting is of unique design, having two separate openings for the escape of air and water from the return of the radiator. This fitting, it is stated, effectively prevents the escape of steam. The closing pages of the catalogue are devoted to illustrations of typical buildings equipped with Trane systems, accompanied, in many cases, with letters from satsfied users. Size 6x9 in. (standard). Pp. 32.



TYPICAL LAYOUT OF TRANE SYSTEM OF VAPOR HEATING.

◆

Pittsburgh's "Smoke Abatement Week."

The last seven days of October were observed in Pittsburgh as "Smoke Abatement Week," the idea being to impress the public generally with the progress that has been made in abating the smoke nuisance in that city. This movement has been in progress in Pittsburgh for four years or more. It involved the establishment of a Bureau of Smoke Regulation, connected with the Department of Health, assisted by many prominent engineers serving as an advisory board. Up to date last year more than 7,500 inspections had been made, which resulted not only in a very noticeable smoke reduction, but in many cases served to bring about an economy in operation.

It is claimed that the outpouring of smoke has been reduced at least 75%, the abatement being particularly noticeable to the traveler familiar with Pittsburgh in former days when it was known as the "Smoky City."

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, published monthly at New York, N. Y., for October 1, 1916.

State of New York }
County of New York } ss.

Before me, a notary in and for the State aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York.

Editor, A. S. Armagnac, 1123 Broadway, New York.

Managing Editor, None.

Business Manager, Gustave Petersen, 1123 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock.)

Heating and Ventilating Magazine Co., 1123 Broadway, New York.

A. S. Armagnac, 1123 Broadway, New York.

Gustave Petersen, 1123 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 12th day of September, 1916. HAROLD MARCOE,

Notary Public Queens County No. 1373. New York County Clerk's No. 29. New York County Register's No. 7030.

(My commission expires March 30, 1917.)

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. DECEMBER, 1916 1123 Broadway, New York

The Testing of House Heating Boilers.

By L. P. BRECKENRIDGE and D. B. PRENTICE.

(Presented at the annual meeting of The American Society of Mechanical Engineers, New York, December 5-8, 1916.)

If all boilers are classified as either power or heating boilers, we define a house heating boiler as one of the latter group designed to serve 2,000 sq. ft. of radiation or less. This is equivalent to a boiler of less than 14.5 H.P. Such a boiler is usually operated with little attention, infrequent firings, low rate of combustion, and automatic pressure regulation by damper control.

The satisfactory testing of house heating boilers by a method which admits of fair comparison is important for three reasons: 1. on account of the increasing cost of anthracite coal it is desirable to determine efficient types of heaters and the most efficient method of burning this fuel; 2. it is desirable to develop efficient types of furnaces for other fuels, such as bituminous coal and coke; 3. by means of standard tests it is desirable to establish a satisfactory rating system which will eliminate the uncertainty of the present manufacturers' ratings of house heating boilers.

REQUIREMENTS IN TESTING HOUSE-HEATING BOILERS.

The authors believe that a method of testing any apparatus to give results of value should meet two requirements:

The apparatus should be tested with as many conditions as possible equivalent to those under which it normally operates (except for particular investigations under special conditions)

Errors should be so far eliminated or reduced that results can be reproduced.

To meet the first requirement with a house-heating boiler it is necessary to operate at a moderate, reasonable pressure, controlled automatically, as would be the condition in an actual installation. It is proper to fire the fuel in rather heavy charges and to give attention to the boiler only at intervals of several hours. The fire should not be frequently shaken or poked. The temperature of the feed water should be comparable to the returns from a radiator system, and the boiler should be supplied with water continuously and uniformly. Perhaps the greatest essential is that the test should be started under average running conditions, with the boiler and covering thoroughly heated to bring the radiation loss to equilibrium, and with a fire neither freshly kindled on bare grates nor clogged with ash; in brief, a good, thin, recently cleaned fire.

The elimination or modification of errors so that results can be verified by several tests presents some difficulties. The measurement of coal fired in the boiler is a matter of careful weighing.

Determining how much coal has been burned is necessarily somewhat uncertain. The method of starting and stopping described later, the authors believe, decreases the error of measurement, yet makes the test under normal running conditions. The low rate of combustion in house boilers and the small amounts of fuel involved make long tests essential. It is necessary to burn at least 40 lbs. of coal per square foot of grate area, or to test for at least 12 hours, to secure results that can be approximately duplicated. The error in coal measurement is then distributed over an amount large enough to make it a small percentage of the total.

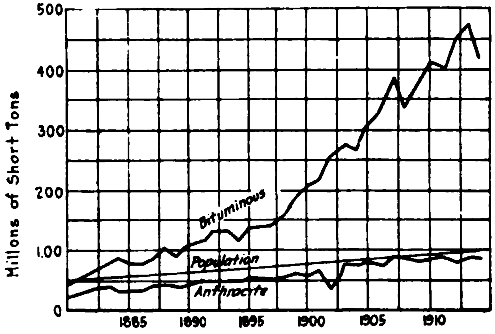


FIG. 1—COAL PRODUCTION IN THE UNITED STATES.

That shorter tests are unreliable is shown by the diagrams of two special tests, Figs. 3 and 4. In these tests, from the start to any one of these endings may be considered a complete test. The evaporation per pound of coal has been calculated for the several periods from the start to the successive closing points, and these performance values are plotted against the elapsed time, that is, the durations of the corresponding periods. The heavy horizontal line represents the average evaporation for the longest period. The vertical distance of any point from this line is the error in the calculated rate of evaporation which would result from closing the test at that time. Very little gain in accuracy is secured by long tests.

CONTROL OF BOILER OUTPUT.

The output of a boiler during a test may be controlled in one of several ways or it may be allowed to vary. The latter condition reproduces, strictly, house operation, where the heating load is uneven, depending on wind and weather. But testing on such a plan would be very unsatisfactory; for the duplication of a test would be a matter of chance, and innumerable experiments might be necessary to produce a performance curve for a fair range of output. Some control is desirable, preferably by a constant and accurate method. Condensation in radiators or piping, the amount of surface that is open to steam being regulated, is too variable. An orifice of some kind is a better control. However, the pressure in the boiler is not even, and the discharge of steam directly through a certain opening would not be uniform.

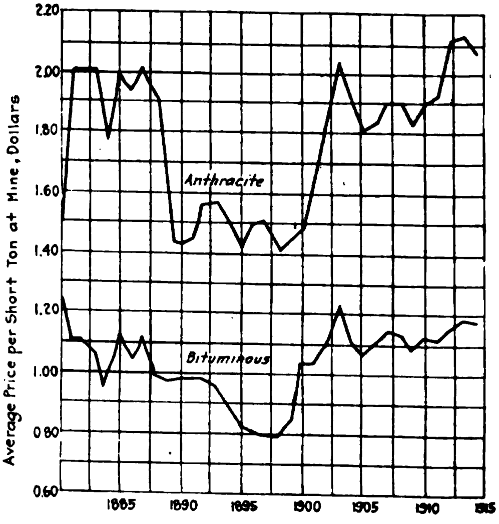


FIG. 2—COAL PRICES AT THE MINES, UNITED STATES.

An excellent arrangement seems to be to maintain a pressure of 2 lbs. per square inch in a receiver by an automatic pressure-reducing valve, the boiler carrying 3 to 8 lbs. The discharge from the receiver through a given area is then constant. The authors believe that a tapering needle valve is more satisfactory than a set of changeable orifices, as it facilitates varying the load during operation. A bank of valves of varying size, opening from the receiver, is another convenient and suitable method of control. The exhaust steam may be used to warm the feed water or it may be condensed and used again.

The method of feeding the water to the boiler is not important provided a steady, easily controlled flow is secured. The measurement of boiler output may be made either before or after the water goes to the boiler. An extremely convenient method is to draw the water supply from a tank fitted with a long gage glass and scale. The level is quickly noted and no "weighing back" is necessary. The tank should be carefully calibrated, by weighing, over the entire range between the extreme levels reached. A duplex water-driven pump is a very convenient device for feeding the boiler wherever city water pressure is available.

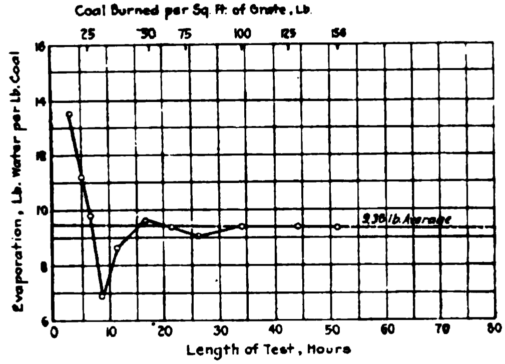


FIG. 3—SPECIAL TEST TO DETERMINE PROPER LENGTH OF HEATING BOILER TESTS.

METHOD OF STARTING TESTS OF HOUSE-HEATING BOILERS.

The authors have found the following method for starting house-heating boiler tests very satisfactory. A preliminary fire is carried until the boiler is well heated and operating at the usual pressure, about 5 lbs. and the load at which the test is to be made. When conditions are considered stable, the preliminary fire is allowed to burn down, the pressure begins to fall, and the fire is shaken, which retards the pressure drop temporarily; but soon a pronounced fall is noticed. The fire is now thin, clean, burned-out, but still hot enough to kindle fresh fuel. When the pressure reaches a given point, perhaps 3 lbs., the necessary measurements are made, including a careful determination of the thickness of the fuel bed, the first charge of weighed coal is fired, and the test is considered started.

When the test is drawing to a close these same conditions are readily duplicated, and at a point, after shaking, when the pressure falls to 3 lbs., the test is concluded. The ash should be shaken out until the thickness of the fuel bed is the same as at the start. The events outlined are characteristic, and a recording pressure gage pictures them very clearly.

The accompanying diagram, Fig. 5, was copied from a pressure chart made during an actual test. The periods of falling pressure immediately before the beginning and ending of the test, as well as before each firing, are quite distinct.

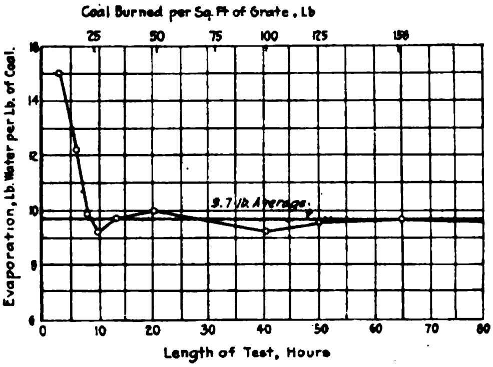


FIG. 4—SPECIAL TEST TO DETERMINE PROPER LENGTH OF HEATING BOILER TESTS.

PROPOSED UNIT OF CAPACITY FOR RADIATORS AND HEATING BOILERS.

The capacity or commercial rating of a heating boiler has always been given in terms of the direct radiating surface which it would serve. The unit usually employed is the "foot of radiation," commonly understood to be that surface which will condense a quarter of a pound of steam per hour at 2 lbs. pressure when in still air at 70° F. Originally the foot of radiation meant a square foot of radiating surface, but improvements in design and arrangement enabled manufacturers to secure this condensation with less surface, and consequently less weight of iron. The result has been a variable and decreasing value in square inches for the "foot of radiation." In fact, the unit has become, as it should, dependent entirely on condensation of steam, which means a heat transfer, rather than on any particular area of metal.

If the unit is considered as a certain number of heat units it is applicable to boilers directly, as well as to radiation. There are many reasons why it would be convenient to have a capacity unit for heating boilers comparable to the capacity unit for power boilers, *i.e.*, the boiler horsepower. The authors propose, therefore, the following definition of a unit for stating the capacity of radiators and heating boilers:

The "foot of radiation" shall be a quarter of a pound of steam condensed from and at 212° F. per hour.

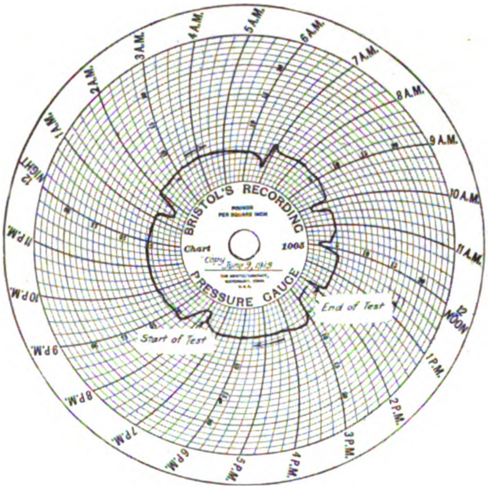


FIG. 5—PRESSURE CHART MADE DURING AN ACTUAL TEST OF A HOUSE HEATING BOILER.

This is equivalent to a heat transfer of 242.6 B.T.U. The condensation of a quarter of a pound of steam at 2 lbs. pressure is equivalent to 241.5 B.T.U. There is, therefore, very little change in the heat equivalent of the unit. Although there is no direct connection between the unit as defined above and a square foot or any particular area of radiating surface, yet the authors favor the retention of the old name for the same reason that boiler horsepower was continued, although that unit bears no relation to the standard horsepower.

The advantages of the above definition of the "foot of radiation" are:

The heating and power-boiler capacity units are based on the same physical conditions.

They are mutually convertible by the factor 138.

Radiation is rated without reference to surface, so that efficient designs and arrangements are benefited.

The unit is applicable to hot-water radiators and heaters by determining the heat transfer. (The result may be called "equivalent feet of radiation.")

The authors recommend that radiator tests to determine rating be made with steam at 2 lbs. pressure and in "still air" at 70° F., and suggest that boilers under test be operated at from 3 to 8 lbs. pressure.

PROPOSED HOUSE-HEATING BOILER CODE.

[The paper proceeds to give the proposed individual code for house-heating boilers to be used in conjunction with the First Section (General Matters) of the Report of the Power Test Committee of the American Society of Mechanical Engineers. This code follows closely the A.S.M.E. boiler code of 1915, differing materially only in the paragraphs dealing with the duration of tests, the method of starting and stopping tests, and the calculation of results. These paragraphs are given below.]

DURATION.

The duration of tests to determine the efficiency of a house-heating boiler should be at least 12 hours of continuous running, or such time as may be required to burn a total of 40 lbs. of fuel per square foot of grate. The duration of tests which include periods of banked fires should not be less than 24 hours. The duration of tests to determine the maximum evaporative capacity of a boiler without determining the efficiency should not be less than 3 hours.

STARTING AND STOPPING.

The conditions regarding the temperature of the furnace and boiler, the quantity and quality of the live fuel and ash on the grates, the water level, and the steam pressure, should be as nearly as possible the same at the end as at the beginning of the test.

To secure the desired equality of conditions the following method should be employed:

The furnace should be well heated by a preliminary run of at least an hour under all the conditions at which it is proposed to test. A suitable pressure for running the boiler while under test is from 5 to 8 lbs. During this run the operation of the pressure-reducing valve and damper control should be tested, and the setting of the output-control valve should be verified. The fire should now be allowed to burn low, which will result in a falling pressure. When the pressure reaches a chosen point (3 lbs. is recommended), the fire should be shaken clear of ash, the thickness of fuel bed noted, the water levels in boiler and feed tank recorded, together with steam pressure, draft, flue temperature and the other usual data. The first charge of weighed fuel should now be fired and the time recorded as the starting time for the test. The test should be ended when the fire has burned low and it is impossible to check the pressure fall by shaking, as at the start.

When the pressure again reaches the chosen point the final readings should be made, the ash shaken out until the fire is the same thickness as at the start, and the time recorded as the stopping time. It is advisable to regulate the feed so that the water in the boiler is brought to the starting level and held there, toward the end of the test. All ash should be removed from the ashpit immediately after the fire is shaken down at the beginning of the test and again at the end. The second lot, with any that may have been drawn during the test, should be carefully weighed.

CALCULATION OF RESULTS.

The method to be followed in expressing and calculating those results which are not self-evident or stated in detail in the Boiler Code of the A.S.M.E. is as follows:

The capacity of the boiler in "feet of radiation" served is found by dividing by 242.6, the total heat absorbed per hour by the water in the boiler, expressed in B.T.U.

Standard Practice in Sheet Metal Work for Ventilation Systems.

WITH SUGGESTIONS FOR A COMPLETE SET OF SPECIFICATIONS.

By T. W. REYNOLDS.

The variations in practice that now exist for the construction of ventilating ducts make desirable a discussion of the question with a view to perfecting a method which may be universally referred to as good practice. Speaking generally, no more trying situation can be created than when the engineer is called upon to approve and accept the usual system as installed by the contractor. How many of these systems are durable and efficient, presenting a minimum of friction losses and leakage and in how many is the distribution of air to the various outlets ever effected in the proper proportions?

All contractors, in common with engineers, evince the same symptoms under the same circumstances. However, there are engineers and contractors possessing individualities all their own, and when an engineer designs a perfect system as seen by himself, he is obstructed by the views of the contractor who installs the system in accordance with his own opinion and as conservatively influenced by his own economy. Often a system is installed improperly due to failure upon the part of the contractor to grasp what is desired by the engineer. The contractor is not an engineer nor is he expected to be, but nevertheless he often becomes a good one, due to his familiarity with standard practice and good judgment based upon practical experience. The contractor, however, tends to construct his work along the lines of least resistance, that is to say, along the lines with which he is most familiar, and anything divergent therefrom is viewed with suspicion.

DUCTS IN GENERAL.

Should the reader care to accept and adopt the statements made herein and embody the same in his standard specifications, he may readily do so as the remainder of this article has been arranged in a modified specification form. We will all agree that ducts should be substantially constructed of sheet iron, well stiffened and braced. Preferably these are of galvanized iron dependent somewhat upon durability and existing economy as weighed in the balance.

The writer specifies ducts of a thickness not less than those given in the following table:

Up to 20 in. wide	No. 24
21 in. to 29 in.	No. 22
30 in. to 39 in.	No. 20
40 in. and upwards	No. 20

braced with angle iron.

Metal exposed to the weather should be two gauges heavier than the above with all stops, sleeves and filling in pieces constructed of No. 24 galvanized iron. These gauges are either U.S.S. or B.S.W. gauge and by wide is meant the longest dimensions. It is, however, quite a common practice for the contractor to construct the short vertical sides of main trunk ducts with metal of a lighter gauge than that forming the top and bottom thereof. The feasibility of this construction is dependent somewhat upon the method of supporting the ducts, whether hung by metal strips attached directly to the upper sheet or by the carrying of these under and around the sides of the ducts.

There is also much which might be said regarding the making of joints across the width of the ducts or running parallel with the same, as well as on the selection of ducts of a size favorable to quick construction and a minimum of labor with a corresponding receipt of a lower bid, this where the intentions upon the part of the bidder are to follow out the dimensions as shown upon the plans.

Joints should be smooth inside the ducts with bracing so arranged as not to interfere with the free flow of air along the ducts. These should be sufficiently strong so as to permit of a man passing along for cleaning. It is advisable to avoid the passing of piping or conduit for wiring through the ducts or otherwise obstructing the same.

Ducts should be constructed and arranged so as to permit of their being readily cleaned. They should be carefully made tight, in particular the exhaust ducts, so that a hose can be used inside without leakage or damage to other work. The latter stipulation permits of no argument as regards the tightness of the metal work and will tend to insure the construction of a good installation.

All metal work in hung ceilings, dead or furred down spaces should of course be erected in time so as to occasion no delay to the other work in hand.

It is well to fit doors and manholes for access to the interior of the ducts wherever necessary. Also a design which has been given the proper consideration will be arranged so as to clear the plumbing and other pipes, this applies to all ducts, flues, access doors and volume dampers.

ERECTION OF DUCTS.

When finished, the sheets of galvanized iron work should be fair and free from buckling and sagging. All seams, joints, and connections to brickwork, plaster, concrete or terra-cotta should be air-tight. All round pipes should be heavily beaded, riveted and soldered if necessary to make them tight. Reserve the right to order any pipe riveted and soldered at any seam if the pipe is not made tight in erecting. Construct vertical ducts or risers so as to be self-supporting, complete in themselves, and allow no single thickness partitions between ducts.

All ducts should be substantially supported with wrought iron hangers to the ceiling or otherwise, depending upon local conditions, placing supports not over six or eight feet apart along the length of the duct. Make all hangers of 1 in. wide galvanized iron, No. 16 gauge and rivet or bolt hangers to sides of the ducts. The upper ends of hangers may be firmly secured to the ceiling slab or to concrete beams by means of expansion bolts. The same method of procedure should be practically followed out in the erection of vertical ducts and flues. Wood plugs driven into masonry should not be approved, nor should nails, wires and cotter pins be run through the ducts. Similarly the punching of holes in any way in ducts to aid in their erection should not be tolerated. If this is done, new sheet metal should be furnished and erected by the party responsible for such conditions. Stipulate that all necessary hangers, braces, tees, angles and supports for the ducts should be provided and secured in a satisfactory manner.

Carefully close all ducts and register openings during construction. This is not always done. Remove all dirt and rubbish, from around and between the Vento heater sections the last thing before the galvanized work is begun and at the completion of the work remove all dirt, debris and rubbish from, in and about the air chambers, heater sections, ducts, register faces, louvres, screens, etc., and wash all ducts, dampers, diffusers, register faces, louvres, etc. with a damp cloth or sponge.

To avoid baffling air currents construct all bends, tees, and elbows in air ducts with easy turns with bends having a radius not less than the diameter or width of the duct. Where ducts are reduced in area, such reduction should be gradual, all sharp edges and corners being avoided. Use sweeps in all ducts where there is a change in direction of the flow of air.

A good practice is to make up ducts with *standing seams having separate cleats mitering at the corners, as shown in the diagrams below.*

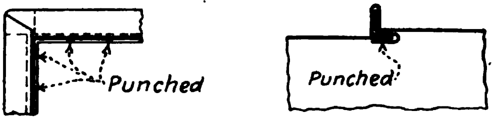
Do not approve ductwork having joints open at the corners. Permit lock seams only in vertical pipes.

On all ducts intended to be covered with insulating material, specify standing seams having a projection not more than three-quarters of an inch from the sides of the duct and with 3/16 in. holes punched 5 in. center to center.

Use asbestos cement for caulking joints to make them tight. Wherever iron ducts terminate in concrete, brick or masonry openings, make tight joints by means of closely fitting heavy flanged iron collars.

DOORS.

Approve the design of metallic doors and set these wherever necessary for access to the interior of the air ducts and to dampers, deflectors, heaters, valves, etc., in the air chambers and ducts. All doors should be of the pan type, large sizes being suitably stiffened with angles and opening in such a way as to be kept closed by air pressure. All doors should be strong, rigid, tight and provided with galvanized iron hinges with turned brass pins and heavy latches. Frames for doors should be of iron construction. Doors for access to main air ducts should be constructed of No. 14 gauge steel plate, suitably stiffened with angle iron frames and provided with a substantial hasp and padlock. Any ladders required for access to doors, interior of ducts and to deflectors in same should be furnished.



APPROVED PRACTICE FOR MAKING SEAMS IN DUCTS.

DAMPERS AND DEFLECTORS.

Each end of a damper or deflector shaft should be supported in a cast iron bearing, one end may be supported by the quadrant which should be provided for indicating the position of each damper or deflector, and the other end by a bearing fastened to the side of duct. It is advisable to approve a sample before proceeding with the work.

At all junctions of ducts or places where air currents divide, fit deflectors consisting of stout galvanized iron sheets. In small ducts under 12 in. depth these sheets can be fixed approximately in position and bent for final adjustment. In larger ducts these deflectors should be of galvanized iron, not less than No. 14 gauge secured along one edge to a substantial ⅝ in. round wrought iron axis working in cast iron bushings attached to sides of duct and provided with set screws for permanently locking the deflector in required position.

Provide a hand hole for access to each deflector. Where cleanout doors are close enough to dampers or deflectors for adjusting same, the hand hole may be omitted. Hand holes may be used to great advantage when finally adjusting the system, the necessary adjustments may be facilitated and the system quickly balanced if intelligently designed, by the manipulation of dampers or deflectors through these hand holes. The general tendency is to leave out either or both hand holes and deflectors even though clearly specified and shown. The exact position of a damper or deflector may be quickly ascertained and may be more accurately known where hand holes have been installed adjacent thereto.

All points where it is necessary to take off supply or exhaust branches at right angles to vertical air ducts or where openings for air occur in the sides of such ducts should be fitted with substantial galvanized partitions inside of duct carried back as directed from point of division, with hand hole in main duct for access, and arranged so as to divert a greater or less amount of air to the branch as may be required.

Provide means for permanently adjusting the ends of division plates in the required positions.

Place a stop damper in the discharge duct of each fan for closing the duct when the fan is not in operation. These dampers should be fitted with quadrants or chains so that they may also be set to regulate the fan discharge and pressure when open. These dampers should work easily and should be mounted on a turned shaft supported by two brass bearings attached to the duct.

The fresh air inlet to the fan should be equipped with movable steel louvres or other approved dampers for completely closing the inlet when required. These louvres should be constructed of 3/16 in. steel plates erected in steel channel frames with connecting rods and operating devices as shown on an approved detail. They should close weather tight on felt strips and should have suitable means for locking in any desired position.

Install fixed louvres to prevent the entrance of rain and snow through discharge openings.

All the above dampers should be of double thickness No. 16 gauge galvanized sheet steel.

It is sometimes the practice to place a volume damper back of each exhaust register face. The control for such dampers should be located back of the register face. Properly adjust these dampers for the flow of air before the register faces are set.

All dampers should be of heavy pattern with large sizes suitably stiffened with angles. They should be made strong, rigid, fitted tightly and provided with angle iron stops if necessary, the design, method of hanging and control being suitable for the location and service required.

All dampers should be provided with suitable chains, catch plates or quadrants as required.

Construct diffusers of substantial galvanized iron in supply register openings wherever necessary. They should be fitted inside of register faces and be painted a dark color so as not to be readily visible, or they may be painted in accordance with the local color scheme. In the opinion of the writer the last is the best method for rendering them least conspicuous.

REGISTER FACES.

Install wood frames in the walls for fastening the register faces to.

The ducts should be brought through the walls and openings left of a size as marked on the plans, the dimensions being as given in a standard catalogue. The contractor is advised to make up the register boxes on the job so as to conform with structural conditions existing at the time of installation.

Special importance should be attached to the manner in which the exhaust register boxes are made up; they should perfectly fit the register frame and face.

so as to be free from pockets in which water or dirt may collect.

Register faces and grilles should be put in place after the building and ducts have been cleaned but before the walls have been painted.

The dimensions given on the drawings refer to the inside dimensions of the opening. Where they are required to be placed in a vertical plane, showing one projection only in plan, the horizontal dimension is indicated first followed by the vertical dimension. All dimensions should be verified at the building.

"Reg" or "R" indicates register with movable louvres.

"Reg. Face" or "R.F." indicates register face without movable louvres, same to be clear of wheel space and screw holes.

"Grille" or "G" indicates wrought iron wire grille.

"B" and "T" prefixed to above indicates bottom or top position, bottom position being taken to mean near floor and top position in side wall with bottom of face usually 8 ft. 0 in. above floor, unless otherwise indicated on the drawings.

"Clg" prefixed to above indicates same is to be placed in the ceiling in a horizontal plane.

Register faces are of cast iron or bronze as required and are usually of the plain lattice pattern though many other designs are readily obtainable. They may be of the "Sanitary" pattern having openings in the face in the form of vertical slots full height of the same, or they may be of cut steel No. 12 gauge with 7/8 in. by 7/8 in. openings having a net air space of not less than 65% of the face. These latter can be furnished with diagonal mesh if desired and with 1/2 in. by 1/2 in. openings. In some instances it is desirable where registers are placed six feet or more above the floor to furnish the same with operating cords, brass or nickel-plated brass chains and required pulley attachments, the ends to be fitted with suitable indicator handles marked "open" and "shut." These may be finished in a variety of ways, in Japan, bronze, plated brass, bronze or nickel, or in solid brass or bronze. Registers of the locking type are usually of the key operating type, if hand operation is desired use a wheel. Floor registers are fitted with floor borders of the same material as the register and under each register face a screen is placed made of 1/4 in. galvanized iron wire bound over a round wire frame, and painted black. For the foot warmer stacks, the warm air opening is covered with a register and the cold or return air opening with a register face.

Register faces used for enclosed radiators should have, where required, a small section of the net-work formed as a secret hinged door, approximately 6 in. by 6 in. in size, and properly located opposite each control valve of the radiator.

Register faces for hinged cast faces should each be furnished with angle iron frame to which the face should be hinged with two butt hinged on one side and a knob catch at the opposite side, use a key lock if desired.

Woven wire grilles are made of No. 10 gauge round iron wire of 1 1/2 in. x 2 1/2 in. diamond mesh spread in 3/4 in. channel iron frame, with 1 1/2 in. x 1 1/2 in. x 1/8 in. angle iron border having mitred and brazed joints at corners. Borders should be securely fastened to the wood grounds, using countersunk wood screws so placed as to be as inconspicuous as possible. Grilles located in side walls should have the long dimension of the mesh placed in a vertical position. Woven grilles are also made of flat strips of 5/16 in. x 1/16 in. iron arranged in square mesh, spaced 1 3/4 in. center to center of strips.

All exhaust grilles should have the channel iron frame hinged to the border using two butt hinges on one side with approved lock and guard on opposite side, the same key to fit all locks.

The fresh air supply grilles should be furnished without hinges, the channel iron frame being attached to the border with machine screws accessible for removal if required.

Registers and register faces set in brick, terra cotta or concrete walls should be furnished with heavy cast iron wall frames. Where placed in metal lath and plaster partitions or ceilings, they should be fitted with 2 in. deep band iron frames, suitable for attachment of the registers or faces.

Each outside air intake window or opening should be provided with a heavy wire screen or guard made of No. 8 gauge round iron wire of 1½ in. x 2½ in. diamond mesh spread in ¾ in. channel iron frame, the frame should be securely attached by screws to the jamb of the opening.

Back of each guard attach a galvanized preferably copper iron wire screen of ¼ in. square mesh on suitable galvanized iron frame.

Guards should be painted or black enameled at the factory before shipment and repainted after erection.

The woven wire grilles for room openings should be bronzed or electroplated at the factory of finish as desired.

Registers and register faces should be painted a flat coat of best lead, zinc and oil paint at the factory, ready for final painting after erection.

ROOM OUTLET CONNECTIONS AND CASINGS FOR VENTO HEATERS.

Each fresh air inlet to room opening should have the flue extended and stopped 8 in. above the room opening, forming an air cushion to equalize the flow of air through opening. Each exhaust air outlet back of room opening should have the flue formed as a curved deflector.

From the fresh air chamber around the Vento stacks and by-pass up to the suction of the supply fan, erect casings of No. 18 gauge galvanized iron thoroughly stiffened with 1½ in. x 1½ in. angle iron braces and fitted with all necessary doors to give access to all parts of the apparatus, doors to be not less than 24 in. x 30 in. in size, constructed as hereinbefore mentioned. The casing around the heater should be made in sections so that it can be readily removed without the breaking of pipe connections, and to permit of access to the heaters.

Provide doors with locks and keys.

The Vento stack casings arranged for gravity supply should be constructed of No. 22 gauge galvanized iron using double lock standing seams, they should be substantially supported and put together with the stack strips and bolts in such a manner as to be readily removed without breaking pipe connections and to permit access to the heaters. Casings should be of double construction which allows for the insertion of ½ in., 85% magnesia blocks. At the side or end of each stack casing provide two heavy 8 in. x 12 in. swinging clean-out doors with suitable catch plate placed in a convenient position. Install one of these doors near the bottom of the casing, the other near the top. The air space over and below the indirect radiators should not be less than 12 inches.

COVERING.

Cover all warm air supply flues in pipe chambers and in suspended ceilings with corrugated asbestocel paper ¼ in. thick securely wired on.

The main warm air supply ducts in the basement should be covered with ½ in. asbestos sheets throughout their entire length. If further consideration need be given to appearance, an 8-oz. canvas jacket may be pasted on this surface.

The casing of vento heaters should be covered with 85% magnesia blocks 1 in. thick wired on, and finished with ½ in. of hard finishing plaster.

PAINTING.

Paint all sheet metal work in pipe chambers and chases. Paint all canvassed duct coverings one coat of glue size, after which apply two coats of best lead and oil paint of color as selected. Paint all uncanvassed sheet metal work as above but omit the glue size. Where lead and oil paint is used, a glue size must first be applied, as otherwise the lead and oil will sink into the insulating material, lessening its efficiency and losing the effect of the paint.

Galvanized iron work where exposed to the weather should be painted two coats of Goheen's "Galvanum" or equal approved paint of color selected.

Register faces should be painted a white flat paint by the manufacturer, suitable for receiving a priming coat by the owner, and as directed by the architect.

Paint all galvanized iron work, masonry, or woodwork exposed to view back of register faces, two coats of "Chrysolite" or equal approved black paint with dull finish as directed by the architect.

Paint the curved galvanized iron deflectors in top of fresh air inlet flues two coats of lead and oil paint of color to match finish of adjacent walls as directed by the architect.

Paint all exposed iron work, pipe, fittings, hangers, etc. two coats of No. 500 Minwax or equal black paint as approved by the architect.

Also paint castings and equipment in the same manner.

The ventilators, shutters, louvres, etc., should be painted after erection two coats of Goheen's "Galvanum" or lead and oil paint as approved and of colors directed by the architect.

Speed Control of Direct-Current Motors in Ventilating Service.

By B. N. STRADER.

Westinghouse Electric and Manufacturing Company.

When the speed of a ventilating fan or blower driven by a direct-current motor must be varied, the question at once arises what method of changing the motor speed should be used. The answer is not a simple one to arrive at, for there are several alternative methods of speed control, and both the first cost of the motor and its cost of operation must be taken into consideration. To supply the data necessary to answer this question is the purpose of this article.

As is well known, there are three methods of speed control for a direct-current motor.

1. Field Control: That is, increasing the rated speed of the motor by inserting resistance in series with the shunt field.
2. Armature control: That is, decreasing the rated speed of the motor by inserting resistance in series with the motor armature.
3. A combination of the two: That is, obtaining speeds below the rated value by armature control and above the rated value by field control, thus giving a very wide range.

Where field control is used it is commonly and correctly spoken of as "increase in speed by field control." However, to make a more uniform basis of operation, it will be dealt with as "reduction in speed" in this article, it being understood that the motor is based upon the maximum horsepower at the maximum speed.

FIELD CONTROL METHOD.

The first or field control method is the most economical from the power consumption point of view and is very satisfactory within the stable operating limits of the motor. Where a large reduction in speed is required, a more expensive motor design is necessary than would be used for armature or combination armature and field control.

ARMATURE CONTROL METHOD.

The second method, *viz.*, armature or rheostatic control, is wasteful in that an appreciable amount of power is consumed in the control resistance. This is a dead loss and at first sight appears to put armature control method out of the question when compared with the field control method. However, as a fan load drops off so rapidly (varying approximately as the cube of the speed) these losses are not comparable with those which would occur in a case where the load is proportional directly with the speed. With an average motor carrying a fan load these rheostatic losses do not exceed 19.2% of the motor input at full load under the worst conditions which occur at approximately 57% full load speed. Here the external losses reach a maximum.

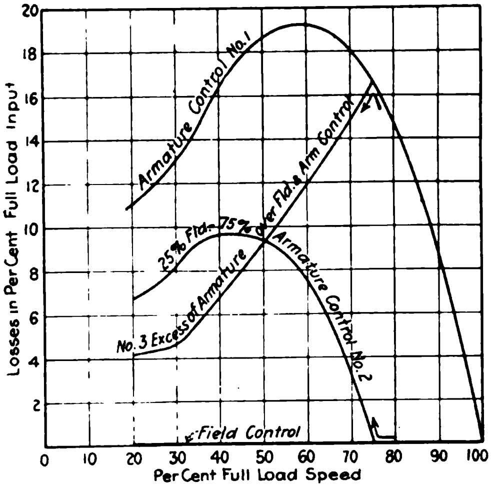


FIG. 1—CONTROL LOSSES OF MOTOR DRIVING CENTRIFUGAL FAN.

ADVANTAGES OF A COMBINATION OF FIELD AND ARMATURE CONTROL.

The third or combination of armature and field control method represents a conservative compromise between the other two methods where the speed variation by field control is slightly greater than the normal variation permitted by the design of the motor. The first part of reduction is effected by field variation, and the second part by armature control. Here it is possible to get the desired range of speed with a less expensive motor than if straight field control method were used and, at the same time, the operating expenses are reduced over the straight rheostatic or armature control. By using field control for the first 25% of the speed reduction and armature control for the last part, the external losses do not exceed 9.7% of the field load input, and this maximum value occurs at approximately 43% of the full load speed.

Fig. 1 shows approximately these losses in percentage of full load input over working speed range. By reference to these curves it will be seen that the maximum loss with a combination method is approximately one-half of the maximum loss with the straight armature control, and that the losses of the latter method are approximately 16½% when the losses of the combination method begin. Curve 3, Fig. 3, shows that the amount (in percentage) in losses with straight armature control exceed those of the combination method. It will be observed that the losses are all on a percentage of full load input basis.

Curves in Fig. 2 show the cost of power per year to operate a motor requiring 10 K.W. input at full load speed, based upon a power cost of 1c per K.W. hour, for simplicity in calculation, running 10 hours per day 365 days per year. The power costs to operate any other motor are in proportion to the full load input of the motor in question to 10 K.W.

Example: Assume 25 H.P. motor 86½% efficiency full load input =

$$\frac{25 \times 0.746}{86.5} = 21.6 \text{ K.W.}$$

At 80% speed the cost per year to operate the 10 K.W. input motor as taken from curves 1, 2 and 3, Fig. 2:

Armature control	$264.00
Field control	214.75
Field and armature control	214.75

The cost per year to operate the 25 H.P. motor is:

$$\frac{21.6 \times 264}{10} = \$570.00$$ with armature control.

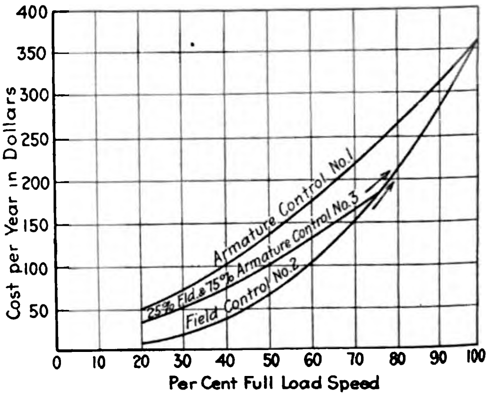


FIG. 2—OPERATING COST OF 10 K.W. MOTOR (INPUT), DRIVING CENTRIFUGAL FAN.

(Cost of power taken at 1 cent per k.w. hr.)

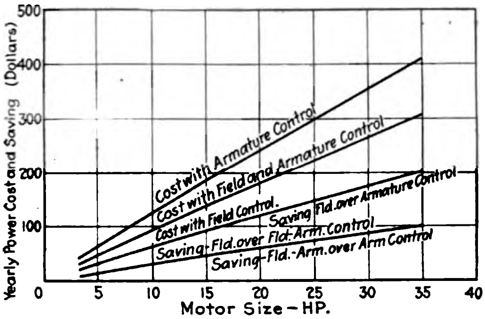


FIG. 3—YEARLY POWER COST AND SAVING WITH DIFFERENT CONTROL METHODS.

(Motors running 10 hrs. per day at 50% speed.)

$\frac{21.6 \times 214.75}{10} = \$463.50$ with field control.

$\frac{21.6 \times 214.75}{10} = \$463.50$ with armature and field control.

Yearly saving with field or armature and field control over armature control at this speed will be \$570.00 — \$463.50 = \$106.50.

At 50% speed the costs to operate the 10 H.P. input motor as taken from curves 1, 2 and 3, Fig. 2 are:

Armature control	$137.00
Field control	68.50
Field and armature control	102.00

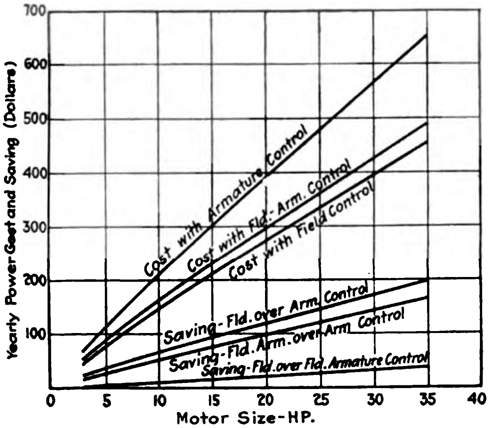


FIG. 4—YEARLY POWER COST AND SAVING WITH DIFFERENT CONTROL METHODS.

(Motors running 10 hrs. per day at 70% speed.)

$\frac{21.6 \times 137}{10} = \$296.00$ with armature control.

$\frac{21.6 \times 102}{10} = \$221.00$ combination armature and field control.

$\frac{21.6 \times 68.5}{10} = \$148.00$ with field control.

The yearly saving is:

\$296.00 — \$148.00 = \$148.00 field over armature.

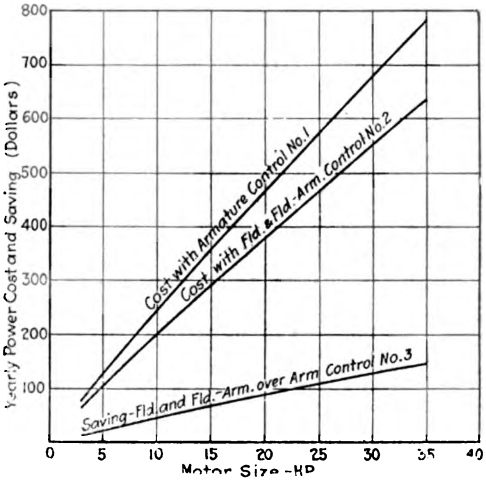


FIG. 5—YEARLY POWER COST AND SAVING WITH DIFFERENT CONTROL METHODS FOR MOTORS DRIVING CENTRIFUGAL FANS.

(Motors running 10 hrs. per day at 80% speed.)

\$221.00 — \$148.00 = \$73.00 field over combination.

\$296.00 — \$221.00 = \$75.00 combination over armature.

The yearly power costs in saving are plotted in Figs. 3, 4 and 5 for motors from 3 H.P. to 35 H.P., for 50, 70 and 80% of full load speed, respectively. In like manner a set of curves can be plotted for any percent. speed reduction allowing the proper motor efficiency in each case, and the yearly saving in power costs of one method over the other is obtainable by subtraction.

APPROXIMATE INITIAL COST OF 400 R.P.M. MOTORS FOR THE THREE CONTROL METHODS.

Prices do not include controllers.

H.P.	Max. Speed *R.P.M.	50% Reduction Armature only	25% Field 25% Armature Reduction	50% Field Reduction	Cost Armature and Field over Armature	Cost Field over Armature	Cost Field over Armature and Field
3	400	$205.00	$240.00	$ 280.00	$ 35.00	$ 75.00	$ 40.00
5	400	270.00	305.00	345.00	35.00	75.00	40.00
10	400	380.00	440.00	490.00	60.00	110.00	50.00
15	400	502.00	587.00	640.00	85.00	138.00	53.00
25	400	660.00	755.00	865.00	95.00	205.00	110.00
30	400	720.00	830.00	950.00	110.00	230.00	120.00
35	400	775.00	890.00	1,035.00	115.00	260.00	145.00

YEARLY SAVINGS IN POWER COST AT 50% SPEED.

		Cost			Savings		
H.P.	Max. Speed R.P.M.	50% Reduction Armature only	25% Field 25% Armature Reduction	50% Field Reduction	Field and Armature over Armature	Field over Armature	Field over Field and Armature
3	400	$ 40.00	$ 30.00	$ 20.00	$ 10.00	$ 20.00	$ 10.00
5	400	65.00	50.00	35.00	15.00	30.00	20.00
10	400	128.00	85.00	65.00	33.00	63.00	30.00
15	400	185.00	140.00	95.00	45.00	90.00	55.00
25	400	300.00	225.00	150.00	75.00	150.00	75.00
30	400	355.00	263.00	175.00	90.00	178.00	88.00
35	400	405.00	305.00	205.00	100.00	205.00	100.00

These figures are based upon 1c per K.W. hour, hence upon a higher rate the savings will be in proportion to the increase in rate.

The interest (depreciation, taxes, etc.), on motor costs subtracted from the savings represent the net gain.

For Example:

* A 3 H.P. 400 R.P.M. motor:

50% reduction by armature control costs	$170.00
25% field, 25% armature costs	200.00
50% field control costs	230.00

The cost of combination:

Field and armature over armature	30.00
Field over combination	30.00
Field over armature	60.00

The yearly savings in power at 1c rate:

Field and armature over armature	$10.00
Field over combination	10.00
Field over armature	20.00

With interest, depreciation and taxes at 12% on the additional motor costs:

Motor Costs:

Armature and field over armature	$3.60
Field over combination	3.60
Field over armature	7.20

The net yearly savings are represented by the difference between the power saving and the interest charges, which in this case are:

Field and armature over armature	$ 6.40
Field over field and armature	6.40
Field over armature	12.80

These figures show no appreciable savings in favor of field control based upon this rate, but if a small user of power used this motor at a rate of say 5c per K.W. hour, the field control method would show a saving of $64.00, or $4.00 more than the additional initial cost of the armature control method motor the first year and in addition show a saving of $64.00 net each succeeding year. This saving will pay for the motor in 3½ years.

It may be generally stated that for

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* The figures for the cost of the motors are arbitrary and are given merely to illustrate the method of calculation.

variations in speed of more than 25% from normal and where the low speeds last for the longest periods of time, the field control method shows the best practical economy. For speeds ranging from nearly 75% to nearly 100% normal, the combination control method type (in this case 25% field control) shows the best practical economy. At or very near full load speed (within 98%) the armature control is the best. In the latter case if the speed is always normal no control system is needed and an ordinary constant speed motor is sufficient.

Heat Transmission Through Various Types of Window Sash

ALSO CAUSES AND PREVENTION OF INTERNAL CONDENSATION IN DOUBLE-GLAZED SASH.

By ARTHUR N. SHELDON.

(Presented at the annual meeting of The American Society of Mechanical Engineers, New York, December 5-8, 1916.)

In the industrial plant of to-day, where there is so much emphasis placed upon maximum daylight, exterior wall surfaces consist principally of windows, and the heat loss through them is a very important matter. Indeed there may be a question in certain plants whether the window area is not carried to excess—that is beyond a point where increased daylight warrants the increased heat loss. In the absence of authentic data on the relative heat loss through various types of sash, these experiments were conducted by Mr. W. S. Brown, under the writer's direction, to enable us to logically design and proportion the fenestration of industrial buildings.

DESCRIPTION OF APPARATUS.

The sash tested were of such a size as completely to fill an opening on the face of a test box 4 ft. 2¾ in. wide by 7 ft. 9½ in. high, the test box being 1 ft. 2 in. deep. The box was constructed of 2-in. tongued and grooved white pine, covered with 2-in. cork boards and made airtight. Wool felt 1 in. thick was placed between the edge of the test box and the sash to reduce air leakage to a minimum. The box rested on two gypsum blocks as shown in Fig. 1.

The test box being set up on end, an electric heater was placed in the bottom. The heater consisted of six sets of resistance wire strung horizontally, and arranged so that, beginning at the bottom, the first two coils might dissipate approximately 0.25 K.W. each of electrical energy, the next two 0.50 K.W. each, and the uppermost two 0.75 K.W. each. The switching arrangement was designed to give a total capacity of 3 K.W., obtainable in successive stages of ⅛ K.W. each. Fig. 2 shows the arrangement of the heater and the ¼-in. asbestos board plates, 15 in. high, which were fastened against the lower frame of a

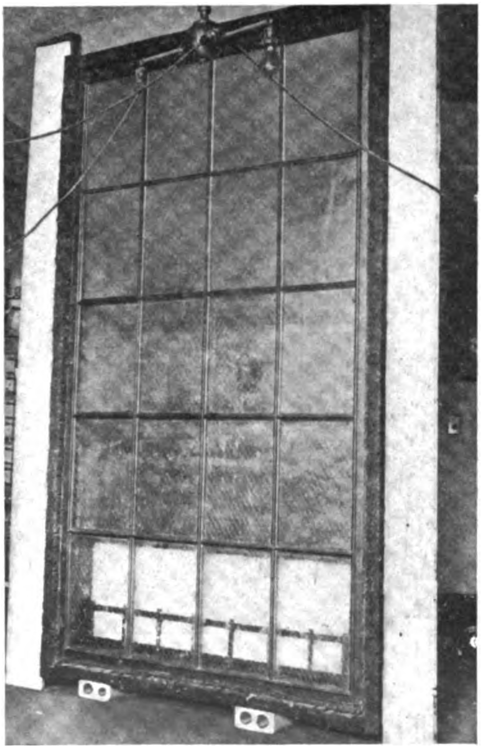


FIG. 1—FRONT OF TEST BOX, SHOWING GYPSUM BLOCK SUPPORTS, BAFFLE BOARDS, HEATER AND SASH.

heater to prevent direct radiation of heat to the lower panes of glass.

Air temperatures within the box were recorded by twelve thermometers, arranged opposite the various panes of glass, and giving a fair average of the internal temperatures. The total average temperature was obtained by averaging the individual temperatures behind each horizontal row of panes. The Fahrenheit long-scale chemical thermometers used protruded about 7 in. through the back of the box and its covering, and were tested for accuracy before and after the experiments.

Air temperatures outside the box were observed by means of an accurate wall thermometer, registering maximum and minimum temperatures. A thermostatically-controlled steam radiator maintained a constant temperature outside. Two electric fans directed currents of air against the test box at an angle of 30 degrees and provided positive and constant circulation over it. While it was not possible or necessary to reproduce actual wind conditions, 11½ miles per hour for New England during the heating season, anemometer readings during the tests showed that the conditions obtained were not far from the average to be expected. Vertical baffles protected the back and sides of the box from the air currents.

Measurements of electrical energy converted into heat were obtained simultaneously by means of two meters, the first a standard indicating wattmeter, accurate within 14 of 1%, and compensated for temperature changes, and the other a standard service watt-hour meter, installed and adjusted by the service company furnishing the power.

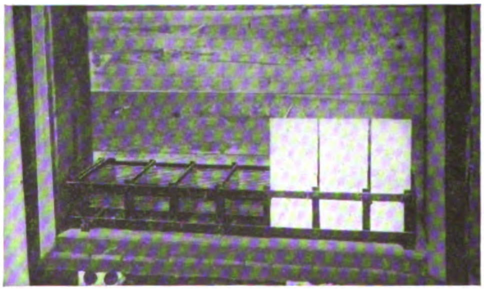


FIG. 2—INTERIOR OF BOX WITH THERMOMETER.

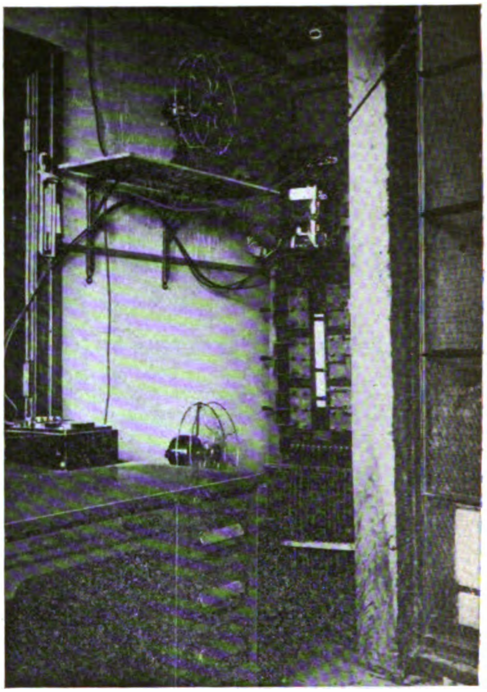


FIG. 3—GENERAL ARRANGEMENT OF FANS, SWITCHBOARD AND METERS.

The humidity of the air was kept as constant as possible throughout the series of tests by means of water-saturated felt, and was measured by a wet and dry-bulb hygrometer. The humidity remained constant during the period of each individual test.

METHOD OF CONDUCTING TESTS.

The average temperature of New England during the heating season being 36° F., it was decided to make tests at a room temperature corresponding to 76°, or a temperature difference of 40°. For greater accuracy, and to obtain the transmission rate in colder weather, there were tests made at 70° temperature difference as well.

To determine what amount of heat was transmitted through the sides and back of the test box, blank runs were made in which the opening in the face of the box was closed by materials of which the box itself was made. These tests were run very carefully over an extended period of time (at least 18 hrs.) to make sure that all conditions had become constant, after which hourly readings were taken for eight hours. The temperature difference during the run did not vary more than 1° F. The fans were not in operation during the blank-run tests, as the object was to determine the rate of transmission through the box and covering under the conditions of the test; still air on top, sides, back and bottom. In order to reduce any slight error due to a possible change in conductivity of the box itself during the experiments, tests were run to obtain these constants at 40° and 70° heat head both before and after the series of sash tests. It was found that a slight increase occurred due evidently to shrinkage and warping of the boards.

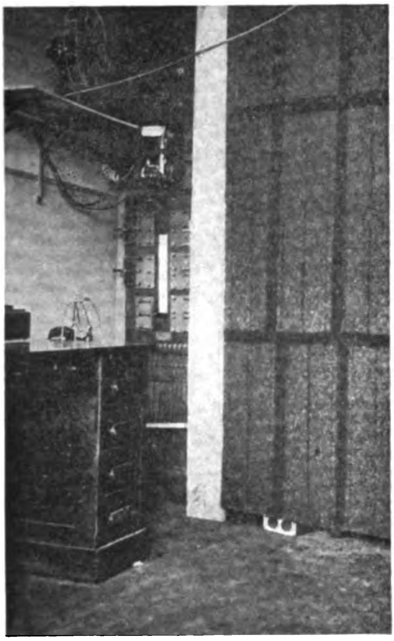


FIG. 4—FRONT OF BOX COVERED FOR BLANK RUN.

Sash tests were conducted in the same manner, except that the fans were put in operation. In each separate test, the watt-hour meter was calibrated for the load by timing it for ten minutes with the instantaneous meter and counting the revolutions of the disk. During all tests, a careful record was kept of the panes of glass on which condensation occurred.

COMPUTATIONS OF TESTS ON HEAT TRANSMISSION.

The heat transmission through the sash has been worked out and expressed on the basis of B.T.U. transmitted per 24 hrs. per deg. F. per square foot of opening, and is designated in the formula following as H, whence

$$H = (L - l)/ad \qquad [1]$$

where

L = total heat loss through test box and sash in B.T.U. per 24 hrs. as computed from wattmeter measurements

l = heat loss in B.T.U. per 24 hrs. through top, bottom, back and sides of test box, as determined from blank run and corrected for actual temperature difference during test

a = area of opening filled by sash = 33 sq. ft.

d = temperature difference throughout test.

L is found from the formula

$$L = (w \times 3412 \times 24)/t$$

where w = electrical energy dissipated in heater as measured in kilowatts at average temperature d

t = duration of test, hours

3412 = the equivalent of 1 K.W. in B.T.U.

In the same manner l is found from the blank-run tests by the formula

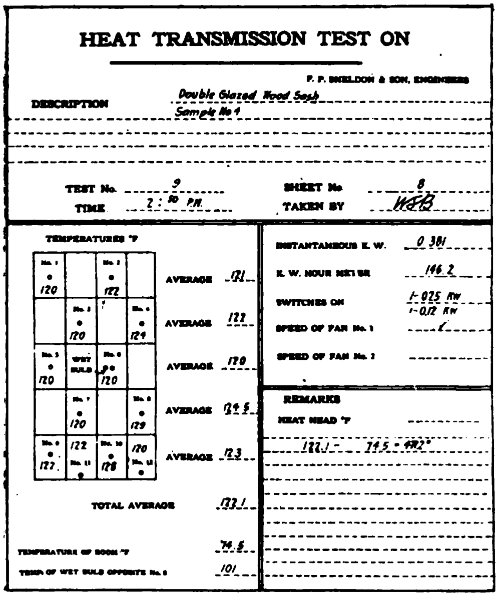
$$l = R\,(w \times 3412 \times 24)/t$$

where R = the ratio of the top, bottom, sides and back of the sash exposed during the sash tests, to the total area of the box, or that exposed during the blank run. As noted above, l should be taken at the same temperature as L by interpolation from the known results, if necessary. The other terms have the same meaning as above.

DESCRIPTION OF THE SASH TESTED.

Tests were conducted on the following seven samples of sash, all without ventilators. The word "pane" refers to a single sheet of glass, whereas "light" refers to a section of sash, or, in the case of double-glazed sash, two panes and the air space.

Sample No. 1 was standard single-glazed, solid, rolled-steel sash of 20 panes, each approximately 12 x 18 in., arranged 4 wide by 5 high. The panes



HEAT TRANSMISSION TEST ON

F. P. SHELDON & SON, ENGINEERS

DESCRIPTION Double Glazed Wood Sash
Sample No 4

TEST No. 9 SHEET No 8
TIME 2:50 P.M. TAKEN BY WSB

TEMPERATURES °F

No. 1 ● 120		No. 2 ● 122		AVERAGE	121
	No. 3 ● 120		No. 4 ● 124	AVERAGE	122
No. 5 ● 120	WET BULB	No. 6 ● 120		AVERAGE	120
	No. 7 ● 120		No. 8 ● 129	AVERAGE	124.5
No. 9 ● 122	122 No. 11 ●	No. 10 ● 128	120 No. 12 ●	AVERAGE	123

TOTAL AVERAGE 122.1

TEMPERATURE OF ROOM °F 74.5

TEMP. OF WET BULB OPPOSITE No. 6 101

INSTANTANEOUS K. W. 0.381
K. W. HOUR METER 146.2
SWITCHES ON 1-0.25 KW
1-0.12 KW
SPEED OF FAN No. 1 1
SPEED OF FAN No. 2

REMARKS
HEAT HEAD °F
122.1 – 74.5 = 47.2°

FIG. 5—SAMPLE HOURLY RECORD SHEET.

were ¼-in. rough wire glass. The sash bar section was 1⅜-in. deep, the glass being bedded on the front side and puttied from the inside, the putty having a good half-inch body. The exposed glass area was 28 sq. ft., or 85% of the total.

Sample No. 2 was a double-glazed solid, rolled-steel sash of the same make, size and arrangement of lights as Sample No. 1. The outside panes were ¼-in. rough wire glass, the inside panes being single-thick plain glass, separated from the former by a galvanized iron channel separator, making a ¾-in. air space. The sash bar was 2⅜ in. deep, the outer pane being well bedded on the outside with a 11/16-in. body of putty. The glazing was done from the inside.

Sample No. 3 was a double-glazed, solid, rolled-steel sash of same size and arrangement of lights as Sample No. 1. The outer panes were ⅛-in. factory ribbed glass (ribs inside) and the inside panes were single-thick plain glass separated from the former by a galvanized-iron channel separator, making a 3/16-in. air space. The sash bar was 1⅜ in. deep, the outer pane being bedded on the outside and the inner pane put on with a good half-inch body of putty. The glazing was done from the inside.

Sample No. 4 was an ordinary double-glazed wood sash, of same size and arrangement of lights as Sample No. 1. The outside panes were ¼-in. rough wire glass, the inside being double-thick plain glass separated from the former by a ⅝-in. air space. The sash was made of 1¾-in. stock, muntin bars being 5/16 in. The outer panes had a 5/16-in. body of putty and the inner panes ½-in. body, bedded. Glazing was done from both sides.

Sample No. 5 was a single-glazed wood sash of the same size and arrangement of lights as Sample No. 1, and was obtained from No. 4 by taking out the inside panes of plain glass.

Sample No. 6 was a double-glazed hollow metal sash. The lights were made larger than those of Sample No. 1, being 14½ in. by 21 in. and arranged three wide and four high. The outside panes were ¼-in. rough wire glass, the inside being single thick, plain glass, separated from the former by a ¾-in. air space. The exposed glass area was 23.5 sq. ft. or 71.5% of the total. The sash bar was 2⅛ in. deep. Muntin bars were 1¾ in. in external width. The outer panes were bedded to the outside and the inner panes were bedded to both sides.

Sample No. 7 was a single-glazed, hollow metal sash, of the same arrangement of lights as Sample No. 6, being obtained from it by removing the inside panes of plain glass, together with the galvanized-iron-formed sections which held them in place. This left the muntin bars 1½ in. deep.

RESULTS OF TESTS.

A résumé of the comparative heat-transmission rates, *H*, of formula 1, as deduced from the tests, is given in Tables 1 and 2.

The results of the tests have been plotted in the form of curves (Fig. 3). It will be noted that the rate of transmission increases with the temperature difference, and that there is a greater increase for the single than for the double-glazed sash.

To ascertain the cause of the much greater heat-transmission rate through solid steel compared with wood and hollow metal sash, a thermometer was inserted in a chamber in a 2-in. cork board, which, in turn, was placed against the

TABLE 1—HEAT TRANSMISSION RATES AT APPROX. 40° F. TEMPERATURE DIFFERENCE.

Sample	Actual Heat Head, Deg. Fahr.	*H* Computed at Actual Heat Head	*H* Corrected to 40 Deg. Fahr. Heat Head	Relative Humidity	Condensation
No. 1 Single-glazed solid steel	44.5	29.3	28.5	36	None
No. 2 Double-glazed solid steel, ⅜-in. air space	37.4	20.4	20.5	34	None
No. 3 Double-glazed solid steel, ⅝-in. air space	45.7	22.8	22.5	43	Very slight on air-space side of one outside pane and box side of one inside pane
No. 4 Double-glazed wood, ⅝-in. air space	47.3	14.2	13.9	49	None
No. 5 Single-glazed wood	41.2	25.6	25.5	44	Hardly noticeable
No. 6 Double-glazed hollow metal, ⅜-in. air space	43.9	15.4	15.2	54	On air-space side of one of outside pane
No. 7 Single-glazed hollow metal	46.0	27.1	26.4	43	All

bars of the sash. These tests showed that for a given temperature difference the steel bars were hotter than the wooden, and by their greater conductivity constituted a direct path for the transmission of heat to the outside. The hollow steel sash bars were warmer than the wood, but cooler than the solid steel. The steel bars also serve to increase the temperature of the air in the same space between panes in the double-glazed sash, and hence increase the transmission rate through the panes.

TYPICAL PROBLEM IN RELATIVE COSTS.

In order to emphasize the practical application of these experiments, a typical problem is given. In the design of reinforced-concrete buildings there arose the question whether to use single or double-glazed steel sash. The following data apply to the problem:

Wall openings to be glazed ....37,800 sq. ft.
Average inside temperature, heating season ...70° F.
Average outside temperature, heating season ...35° F.
Average temperature difference, 70 — 35° F. ..35° F.

TABLE 2—HEAT TRANSMISSION RATES AT APPROX. 70° F. TEMPERATURE DIFFERENCE.

Sample	Actual Heat Head, Deg. Fahr.	*H* Computed at Actual Heat Head	*H* Corrected to 70 Deg. Fahr. Heat Head	Relative Humidity	Condensation
No. 1. Single-glazed solid steel	73.9	34.2	33.6	28	All
No. 2 Double-glazed solid steel, ⅜-in. air space	76.8	21.8	21.6	29	15 outer panes out of 20 showed moisture on air-space side
No. 3 Double-glazed solid steel, ⅝-in. air space.	76.0	24.2	24.0	30	One outer pane showed moisture on air-space side; one inner pane showed moisture on box side. Three lights showed both above
No. 4[1] Double-glazed wood, ⅝-in. air space	79.8	15.5	15.1	31	None
No. 5 Single-glazed wood	67.6	28.9	29.3	29	12 lights
No. 6 Double-glazed hollow metal, ⅜-in. air space	75.6	16.6	16.4	36	On air-space side of one outside pane
No. 7 Single-glazed hollow metal	77.7	30.5	29.7	25	All

[1] A test upon this same wood sash with the inside single-thick plain glass substituted for the double-thick showed an increase in *H* of 3 per cent at 70 deg. fahr. temperature difference.

Heat delivered from steam plant per pound of coal.8500 B.T.U.
Length of heating season ....4850 hours
Cost of coal per 2000 lbs..$4.00
Assumed cost of hot-water heating plant per square foot of heating surface, including heater, based on — 10° F. outside temperature $0.60

Proposition A, single-glazed steel sash. From the tests, *H* at 35° F. = 27.7 B.T.U per degree difference in temperature per square foot per 24 hours.

Comparative yearly coal bill[1].	$ 1,750.00
Comparative initial investment cost of sash erected	15,600.00
Cost of heating system to supply window loss only, based on 18,400 sq. ft. at $0.60 ..	11,404.00
Total investment ...	$26,640.00

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[1] $$\frac{\$4.00 \times 37{,}800 \text{ sq. ft.} \times 27.7 \text{ B.T.U.} \times 4850 \text{ hrs.} \times 35° \text{F.}}{2000 \text{ lbs.} \times 24 \text{ hrs.} \times 8500 \text{ B.T.U.}} = \$1{,}750.00$$

Proposition B, double-glazed steel sash, 3/16-in. air space. From the tests, *H* at 35° F. = 22.3 B.T.U. per degree difference in temperature per square foot per 24 hours.

Comparative yearly coal bill	.$ 1,410.00
Comparative initial investment cost of sash erected	21,000.00
Cost of heating system to supply window loss only, based on 12,800 sq. ft. at $0.60 ..	7,680.00
Total investment	...$28,680.00

Proposition C, double-glazed steel sash, ¼-in. air space. From the tests, *H* at 35° F. = 20 B.T.U. per degree difference in temperature per square foot per 24 hours.

Comparative yearly coal bill	.$ 1,260.00
Comparative initial investment of sash erected	25,750.00
Cost of heating system to supply window loss only, based on 11,500 sq. ft. @ $0.60 ..	6,900.00
Total investment	..$32,650.00

From Table 3 it is evident that an investment of $2,040.00 for B over that for A would result in an annual saving of $340.00 worth of coal, or 17% gross on the additional investment. Also, an additional investment of $6,010.00 for C over that for A would result in an annual saving of $490.00 worth of coal, or only 8% gross on the additional investment. The choice, therefore, lies between A and B; and whether or not B should be preferred will depend largely upon what the owners expect to make upon their other investments. It should be emphasized here that with a different unit cost of coal, a warmer or a cooler climate, or a different heating system, the conclusions might be changed entirely.

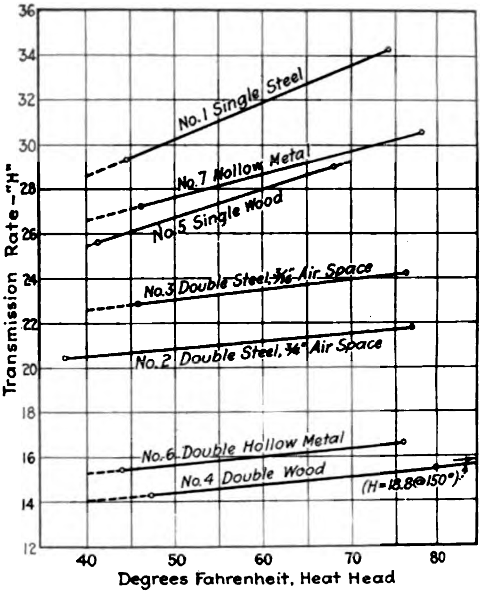


FIG. 6—DIAGRAM OF VARIOUS TRANSMISSION RATES, H, FROM TESTS.

INTERNAL CONDENSATION IN DOUBLE-GLAZED SASH.

Where condensation occurred in the air space, it was always on the outside pane of glass, which, of course, was the cooler one. The wood sash showed none, but it was very marked in the solid steel, and noticeable in the hollow metal sash. To determine, if possible, the cause for this condensation, holes were bored in some of the lights of the solid steel sash which had shown condensation, and in some which had not. Each light was then tested by blowing smoke into the hole, and some were found to leak considerably, some to adjacent spaces, others to front or back, and a few showed combination of those conditions. It was observed that where condensation was evident, the greatest leakage was to the inside of the box, and that where there was no condensation, the greatest leakage was to the air outside the box.

TABLE 3—SUMMARY OF RESULTS.

		Initial Expenditures		
	Yearly Coal Bill	Sash	Heating System	Total
Proposition A	$1,750.00	$15,600.00	$11,040.00	$26,640.00
Proposition B	1,410.00	21,000.00	7,680.00	28,680.00
Proposition C	1,260.00	25,750.00	6,900.00	32,650.00

Following this clue, the entire sash was reglazed, and holes bored in seven of the outer panes, and in five of the inner panes. Free communication was thus established either to the external cool air or to the warmer air inside the test box. Each pane of glass opposite those with holes was carefully bedded to confine and control the air leakage to the side having the hole. Smoke tests before and after each run showed that the desired object had been attained by this means. The remaining eight lights were made as air tight as possible on both sides by careful bedding and setting. The sash was then placed on the front of the box as in the previous tests, the temperature raised to about 70° F. above that of the surrounding room, and records were kept as before of temperatures, relative humidity, and condensation, this being allowed to accumulate for a period of at least eighteen hours. The relative humidity in the test box was maintained at 40%, and that of the air outside varied from 60 to 90%, apparently having little effect upon the results.

A careful examination of the sash showed uniformly the following results:

a. Lights in which the air space opened to the outside or cooler air only showed no condensation.

b. Lights in which the air space opened to the warm air inside the box showed much condensation.

The sash was then reversed with its outer side toward the interior of the test box and, after a test of three days, examination showed that the air spaces in which there had been condensation during the previous tests were now dry, while abundant condensation appeared in those which showed none in the first test. It was also discovered that by varying alternately the temperature in the test box, the processes of condensation and drying could be accelerated. The experiment on the reversed sash, therefore, confirmed conclusions *a* and *b* above.

The explanation is simple. Changes of temperature on either side of the sash cause corresponding, though less marked, changes in the temperature of the air space. The pressure of the confined air, therefore, becomes more or less than atmospheric and air is correspondingly either forced out or admitted through the drilled holes, and, if the temperature difference is alternately increased and decreased, a breathing action obtains in the air space. A similar action occurs through leaks in actual practice and is due to variations in temperature.

Air entering an opening of this kind from the inside, coming as it does from the warm interior of the test box or building, becomes chilled, condensation necessarily appearing if the cooling is carried below the dew point. Breathing, or a repetition of this process, necessarily results in a gradual accumulation of condensation.

Conversely, air entering an opening of this kind from the outside becomes heated and its relative humidity is correspondingly decreased, making impossible the precipitation of any moisture.

CONCLUSIONS.

Condensation in the air space of double-glazed sash can be eliminated almost entirely by connecting the air space directly to the outside air, and at the same time effectively sealing it from the entrance of warm air within the building. In attempting the design of double-glazed sash according to these principles, it is suggested that the following points be considered:

a. The opening should be very small, say a hole ⅛-in. hole, to prevent a direct loss of heat by convection from the air space.

b. The location of the breathing hole is immaterial, except that a consideration of heat economy makes the bottom preferable.

c. The breathing hole should be protected from the weather and dirt.

d. A high-grade, elastic putty should be used. On account of wind pressure, difference of expansion between steel and glass (about 65%), careless setting, etc., absolute sealing of the inner panes probably will not be accomplished. However, these tests, show that a sufficient degree of tightness can be obtained, and that the larger part of the breathing will occur through the opening made for this purpose.

e. Leaks between air spaces should be eliminated.

Fuel Economies in House Heating.

By H. R. JOHNSON

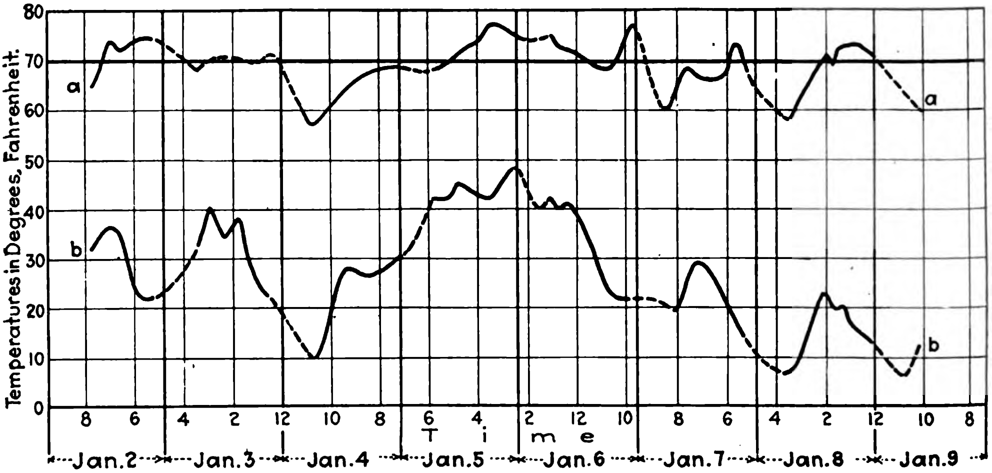
Throughout the northern states, the available kinds and grades of fuel for house heating, and their *relative* as well as *actual* costs, vary widely in different sections. Moreover, the results obtainable with a given fuel are dependent to quite an extent upon the type of heater employed. Hence the results of one set of tests are to be applied with caution to any other set of conditions; and for close results, it is practically necessary for anyone to try the thing out for oneself.

The following description of the methods used by the writer in settling this problem may be of interest. The apparatus required consisted only of two thermometers, an ordinary coal scuttle and a spring balance. The extra time required would hardly exceed fifteen minutes per day, so that there is no reason why similar tests should not be carried out by anyone desiring to do so. The immediate as well as incidental knowledge gained will almost certainly pay for the slight amount of trouble involved. For example, we found out that, by using "pea" size anthracite instead of "egg," we could save over one-quarter of our costs; and, by using bituminous coal, we could save slightly over one-third. We also found that of three one-ton lots of coal, that were completely weighed, one fell short of the supposed weight by 85 lbs.; the second, 210 lbs., and the last 64 lbs. Close attention to the problem for a considerable length of time added much to our knowledge of proper furnace management.

GENERAL SCHEME OF TESTS.

The general scheme of our tests took into account the fact that the number of heat units required per hour to maintain comfortable room temperature depends directly upon the difference between the inside and outside temperatures, and also, but less definitely, upon the average wind velocities. The inside and outside temperatures were therefore recorded at sufficiently short intervals so that a close determination of the average daily difference could be made. Our outdoor thermometer, being of the maximum and minimum, self-recording type, gave us the lowest point reached during the night. It was found, however, that during normal weather, the lowest temperature was reached at about 6 or 7 a. m. and could be read after rising.

Since temperature readings were



TYPICAL CURVES SHOWING TEMPERATURE VARIATIONS.
a living room. *b* outside.

TABLE 1

Date	Time	Temperatures, Deg. F.		
		(a)	(b)	(a—b)
Jan. 2	9 a. m.	63.7	31.5	*16.1
	1 p. m.	70.4	33.5	40.5
	5 p. m.	73.7	28.0	45.7
	9 p. m.	74.5	22.0	52.5
Jan. 3.	1 a. m.	71.7	24.5	47.2
	5 a. m.	68.0	29.5	38.5
	9 a. m.	70.0	39.5	30.5
	1 p. m.	70.0	35.2	34.8
	5 p. m.	69.8	31.5	38.3
	9 p. m.	71.0	22.2	48.8
Jan. 4	1 a. m.	67.5	16.5	51.0
	5 a. m.	58.5	10.5	48.0
	9 a. m.	60.0	16.0	44.0
	1 p. m.	64.5	28.0	36.5
	5 p. m.	67.0	26.0	41.0
	9 p. m.	68.1	27.5	40.6
Jan. 5	1 a. m.	68.5	32.0	36.5
	5 a. m.	68.3	38.5	29.8
	9 a. m.	68.8	42.0	26.8
	1 p. m.	72.0	44.0	28.0
	5 p. m.	75.2	42.0	33.2
	9 p. m.	74.0	46.0	28.0
Jan. 6	1 a. m.	75.5	49.5	26.0
	5 a. m.	74.0	40.0	34.0
	9 a. m.	72.0	40.5	31.5
	1 p. m.	70.0	36.0	34.0
	5 p. m.	68.0	27.0	41.0
	9 p. m.	73.0	21.1	51.9
Jan. 7	1 a. m.	71.1	21.2	49.9
	5 a. m.	62.5	19.7	42.8
	9 a. m.	67.7	25.0	42.7
	1 p. m.	66.1	28.5	37.6
	5 p. m.	66.7	22.8	43.9
	9 a. m.	69.4	14.7	54.7
Jan. 8	1 a. m.	62.6	10.0	52.6
	5 a. m.	58.8	7.4	51.4
	9 a. m.	63.0	10.0	53.0
	1 p. m.	69.7	22.0	45.7
	5 p. m.	72.2	19.7	52.5
	9 a. m.	72.8	15.0	57.8
Jan. 9	1 a. m.	68.8	11.2	57.6
	5 a. m.	64.0	7.0	57.0
	9 a. m.	59.5	12.5	*23.5

Sum of (a-b) readings = 1777.4

Average (a-b) = sum ÷ 42 (readings) = 42.32

* $\frac{a-b}{2}$ for first and last readings in order to figure correct average.

necessarily taken at more or less irregular intervals, it was necessary to plot the readings in the form of curves, from which, in turn, close approximate values could be taken for any hour desired. Fig. 1 is a typical set of curves covering a seven-day test. The dotted portions of the curve, representing temperature variations, during the night, are assumed from the trend of actual readings.

At the end of the tests, usually lasting for four to seven days, the *average* difference between the inside temperature (a) and the outside temperature (b) was determined as indicated in Table I, the values shown being taken from the curve for equal intervals of four hours.

In the meantime a careful record was kept of the number of pounds of fuel burned, care being also taken to have the depth and condition of the fire as near the same as possible at the beginning and end of the test. (Tests should begin and end at the same time of day.)

The consumption of various fuels was reduced to a basis of pounds of coal per degree temperature difference (a-b) for one day. For the test just cited, the fuel was anthracite pea, of which 649 lbs. were burned in seven days. Our factor for comparison for pea coal is therefore

$$\frac{649}{7 \times 42.32} = 2.19 \text{ lbs.}$$

Table II gives a comparative summary of results obtained with two other fuels.

The "Comparative Cost Factor" which appears at the end of the table takes into account the differences in price of the samples of coal under test, and gives the final comparison of the cost of doing an equivalent amount of heating with each kind. This factor is found by multiplying the "consumption factor" by the cost per pound of the fuel under test.

COMPARISON OF RESULTS.

In comparing the results of such tests a certain amount of judgment is required unless the conditions of weather and outside temperature are very nearly the same during each test period. During

TABLE II

	Test No. 1	 2	 3
Kind and Size of Fuel	Lackawanna Egg	Anthracite Pea	Cumberland Bituminous
Amount of Fuel, Pounds	423	649	552
Amount of Refuse, Pounds	54	97	53
Refuse, percentage of Fuel	12.7	15.0	9.5
Average temperature difference (a-b), Deg. F.	40.26	42.32	45.04
Average wind conditions	Moderate	Moderate	Fresh
Duration of Test, Hours	108	168	120
Comparative Consumption Factor, Lbs.	2.32	2.19	2.45
Price per Ton	$8.00	$6.00	$5.00
Comparative Cost Factor, Cents	0.928	0.657	0.613

windy weather somewhat more fuel will be required, which will reflect unfavorably on the fuel under test. Differences in outside temperature may affect the cost factor either way, since the efficiency of the furnace increases with the demand put upon it up to a certain point and, beyond that point, falls again quite rapidly. Before starting a record test, a new fuel should be used until a certain familiarity has been gained with the changes in method of management which may be required to get good or comparable results.

It will be noted that in the tests just cited a very fair comparison seems to have been made possible, except that in the case of No. 3 the stronger wind prevailing had a slightly unfavorable effect.

MANAGEMENT OF THE HEATER.

This is another opportunity for immediate economies. This does not refer to the endurance of discomfort in order to use less heat, but to the possibilities of operating the heater so as to get the needed heat with less fuel consumption. A lengthy article might well be written with reference to this subject. We shall, however, refer only briefly to a number of the most important points, as follows:

(*a*) Run as steady a fire as possible; *i.e.*, try to maintain the desired temperature by running a fire to suit the requirements, rather than by alternately forcing and checking.

(*b*) Anticipate changes in temperature as much as possible and *gradually* force or retard the fire to meet the expected demand, thus avoiding sudden checking or forcing, or disturbance of the fuel bed by excessive shaking or poking.

(*c*) Attend the heater often enough to prevent dead spots or holes from forming in the fuel bed.

(*d*) Excessive shaking causes loss of fuel through the grate. Except in severe weather the ashes should be shaken down not oftener than two or three times daily, and then only until a glow is to be seen in the ash-pit.

(*e*) Keep the fire pot well filled and rounded up. Decreasing the thickness of the fire is only to be recommended when necessitated by the use of small grades of coal or by weak draft.

(*f*) When burning other fuels than anthracite coal, the so-called coking method of firing is to be recommended, the object being to more completely burn the volatile products which are given off by fresh fuel. Before adding fuel push the top of the fire to one side, forming a bank that will not be covered after the firepot is fully filled. This bank of incandescent coals will readily ignite the gases given off by the green fuel.

(*g*) Regulate the fire by operation of both ash pit and check drafts. Under average conditions about the best results will be obtained, with a minimum of manipulation, by connecting the two through a system of chains and pulleys so that one opens automatically as the other is closed. Closer attention is likely to be given the drafts during the day time, by connecting the drafts by chains to a suitable wall attachment in the living room, hall or similar convenient place. The *best* results will be obtained by the use of a good type of automatic draft regulator, several of which are on the market.

(*h*) Never check the fire by leaving the feed door open. (Some fuels require the admission of a slight amount of air above the fire, the small damper in the fire door is, however, ample for the purpose, and is not needed when using anthracite coal.)

(*i*) Keep heating surfaces, or flues, swept clean so that they will readily absorb heat.

◆

Heating and Ventilating System for San Francisco's City Hall

The wide publicity given to the new city hall, in San Francisco, which has risen from the ashes of what was only a few years ago a fire and earthquake-ridden city, lends special interest to the elaborate heating and ventilating plant, which was installed in this building according to the design of Leland & Haley, consulting mechanical engineers, of San Francisco. The following description of the system was contributed by William E. Leland, S.B., to The Architect and Engineer, of San Francisco:

The heating and ventilating apparatus has been designed as a combination system, with direct radiation supplying all the heat required for the entire building, with an additional mechanical system of ventilation for the entire first floor and basement and for all court rooms.

The heating is accomplished by direct radiators located in each room and supplied with steam from the municipal power plant for the Civic Center. The piping system is arranged for the circulation of steam by the mechanical vacuum system, with vacuum pumps located in one of the fan rooms in the basement. The piping is arranged on the overhead system, with down feed risers and return mains in the basement.

All of the direct radiators in the principal rooms are automatically controlled by thermostats, so the room temperature is maintained at a constant point without attention.

The ventilating apparatus for the first and basement floors consists of two fresh air supply fans, each designed to deliver 43,000 cu. ft. of air per minute, together with two exhaust fans of about the same capacity, each pair of fans serving half of the space in these two floors.

The fresh air is brought down from the roof through two large air shafts at the side of the central dome and passes through air washers and heating stacks in the fan rooms in the basement, where it is thoroughly cleaned and moistened and heated to a temperature of about 75°. This temperature is automatically regulated by a thermostat in the main duct. From the fans the air is distributed to the various rooms through galvanized iron ducts on the basement ceiling.

The exhaust air is similarly collected from the rooms and is drawn out by the two exhaust fans and discharged to the roof through two large exhaust shafts similar to the fresh air fans.

The court rooms on the two upper floors and the Supervisors' chamber and a few important rooms on the second floor are similarly ventilated by four fresh air supply fans located in the attic. Each of these fans supplies one-quarter of the building and is designed to handle an average of 20,000 cu. ft. of air per minute.

The air is drawn in from the roof as in the case of the basement fans and is passed over air washers and heating stacks and heated to a temperature of approximately 75° and is discharged to the rooms through a system of ducts and flues.

For all of these rooms in the upper stories vent flues have been provided running to the attic space, which in turn is vented to the outside air by screens set all around the inner court walls.

The toilets are arranged in tiers in each corner of the building and each tier is provided with an exhaust fan with flues connected to each toilet. This exhaust ventilation is also extended to all the smaller toilets throughout the building that have no direct outside ventilation.

The four toilet exhaust fans are designed to handle from 4,500 to 8,500 cu. ft. of air per minute each, depending on the number of toilets on the system.

A small individual exhaust fan has been provided for the chemical laboratory in the basement and a similar small exhaust fan for the blueprint department in the attic.

The apparatus as a whole provides for the supply of approximately 19,800 sq. ft. of direct steam radiation, 5,376 sq. ft. of indirect Vento radiation in connection with the fresh air supply, a total fresh air supply of 166,000 cu. ft. per minute, a total mechanical exhaust of 112,000 cu. ft. per minute and approximately 830 gal. of circulating water per minute for the air washers.

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IT IS surprising how many public projects nowadays depend for their success on mechanical ventilation. The latest to be included in this category is the proposed new vehicular tunnel under the Hudson River, connecting New Jersey and New York. This, to be sure, is a revival of an old scheme, but unlike the conditions that had to be met in former days, the principal reasons for and, strangely enough, the principal objection to, the construction of the tunnel is the automobile. In seeking an easy and rapid route from the Jersey suburbs to the metropolis, the tunnel plan has many advantages, but it appears to have been entirely overlooked that the exhaust gases from automobiles would prove an almost insurmountable obstacle to its feasibility.

It will be recalled that when the first plans were made for the New York Subway, it was before the advent of the electric motor and the original scheme always included trains drawn by coal-burning steam locomotives. Fortunately for all concerned, the first project was not carried out for other reasons, but it is easy to see now that the presence of the locomotives was sufficient in itself to foredoom the plan to failure.

In the case of the projected New York-New Jersey vehicular tunnel, it is estimated that its length, with the necessary approaches, would be not less than 1½ miles and that it could be ventilated only from the ends. According to expert opinion, it would be impossible to run safely even a moderate number of automobiles through such a tunnel, as the amount of carbonic oxide, to say nothing of unburned gas, would be too great to be handled in any practicable manner by ventilating fans.

The same expert refers to the use of gasoline locomotives in coal mines, but here, he states, a powerful forced ventilation exists and the amount of gasoline burned is a mere trifle compared with the amount that would be required to move the automobile traffic that now crosses the North River. Yet the fumes from gasoline locomatives in coal mines have proved so objectionable that their use, in some cases, has been abandoned.

All of which is another evidence of the important place mechanical ventilation is assuming in modern life.

◆

FOLLOWING previous special issues of THE HEATING AND VENTILATING MAGAZINE on air conditioning (July) and smokeless boilers (October), we take pleasure in announcing the January issue as an "Industrial Number." In that issue will be shown some of the advances that have been made in the adoption of better heating methods in industrial plants generally, as well as some of the more important industrial processes in which properly-designed heating and ventilating apparatus has become a prime necessity.

The Consulting Engineer

"The Consulting Engineer" is prepared to reply in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

68—A Problem in Handling Condensation.

QUESTION: A high school is to have an annex building 135 ft. away from the main school. It is to be heated with steam taken from the main boiler in the high school. The minimum outside temperature is to be about 40° F. below zero, and heat will be required in the building about eight months out of the year. It is estimated that 720 sq. ft. of direct steam radiation will be required to heat the building to 70°.

The annex is so situated that it is not possible to get a gravity return back to the boiler. Our problem then is whether it will be profitable to waste this condensation, or whether the saving in using a condensation pump and returning the water to the boiler would be worth while. This is a problem that is very common to this locality, and we would appreciate it if you would give us your figures as to which would be the most economical to use.

ANSWER: Our correspondent does not state the price of fuel, price of public service current or the price of water in the section referred to, also the contemplated steam pressure is not given or whether automatic heat control is used in the school. We will, however, make the assumptions necessary to demonstrate the method and the results can be modified to suit individual conditions.

There are several methods of overcoming this trouble:

1. By means of a hydraulic pump placed in the annex, wasting the cold water to sewer, always provided there is sufficient street pressure.
2. By electric motor-driven pump and receiver, with automatic starting and stopping devices.
3. By raising the boiler pressure, placing a reducing valve on the steam line and operating two return traps in the annex building, as well as one for the main building.

The first requirement will be to find the cost of water and heat lost by wasting the condensation. We will assume the system operated at all times when the temperature is below freezing and only during school sessions when the temperature outside is above 32° F., or freezing. The hours of operation will be approximately as follows:

Outside Temperature, Deg. F. below zero.	Sessions 30 hours.	Non-sessions, 67 hours.
0 to 10	50	257
10 to 20	110	750
20 to 30	270	1168
30 to 40	200	950
40 to 50	232	...
50 to 60	182	...
Total	1074	3192

We will assume 50% capacity of the apparatus in condensation above 30° outside, and 100% capacity below 30° outside. Then there are at 100% capacity: non-session, 2242 hrs.; session, 460 hrs., or a total of 2702 hrs. With a capacity above 30° F. of 50%, there are 950 non-session hours and 614 session hours, or a total of 1564 hours. 1564 hrs. at 50% capacity = 0.15 lbs. condensation per square foot of heating surface. 2702 hrs. at 100% capacity = 0.3 lbs. condensation per square' foot.

The total condensation for the season will be:

720 sq. ft. x 0.3 lbs. x 2702 hrs. = 583,632 lbs. water.

720 sq. ft. x 0.15 lbs x 1564 hrs = 168,912 lbs. water.

Total 752,544 lbs. water.

752,544 ÷ 62.5 = 12,041 cu. ft. per season and at $1.00 per 1000 cu. ft. this will be $12.04 as the cost of the water wasted.

The heat lost in fuel by wasting condensation and heating new feed water, assuming the cold water at 50° F. and that the condensation leaves the heating system at 200° F., will be 150 B.T.U. per pound. 150 x 216 = 32,400 B.T.U. per hour, or approximately 1 boiler horsepower increased load on the boiler, or in ordinary square feet of direct radiation, at 259 B.T.U. per square foot: 32,400 ÷ 250 = 130 sq. ft. of radiation additional capacity. The actual fuel wasted would be represented as follows, if we allow an efficiency of 50% as the portion of heat of coal delivered in steam by the boiler (figuring coal at 12,000 B.T.U. per pound, anthracite).

$$\frac{150 \times 752{,}544}{0.5} = 225{,}763{,}200 \text{ B.T.U. per season.}$$

$$\frac{225{,}763{,}200}{12{,}000 \times 2{,}000} = 9.4 \text{ tons of coal}$$

per year. If coal is $6.00 per ton the cost will be:

Coal	$56.40
Water	12.04
Total	$68.44

If a hydraulic pump were used, with a water pressure of about 35 or 40 lbs., it would probably use twice as much as would be pumped back to the boiler or, if $12.04 worth of water was to be pumped, the cost of operating the pump would be $25.00 per year, plus interest, depreciation and upkeep of pump.

If electric current were purchased at 5c. per kilowatt hour, and the pump were automatically regulated, the current consumed would be, if 752,544 lbs. of water were raised against, say, 40 ft. head, which would be the maximum pressure of the boiler, plus friction of water in the pipes:

$$\frac{752{,}544 \times 40 \text{ ft.}}{33{,}000 \text{ (ft. lbs.)}} = 912.12 \text{ horsepower hours}$$

and multiplying this by ¾ will give the kilowatt hours, or 684.12 kw. hrs.

If the pump were 50% efficient, the kilowatt hours would be 1368.24 which at 5c = $68.41 as the cost of the current, or just about what it would cost to waste the condensation.

The trap system would cost about $500.00 to install properly as it would require two return traps and connections, but the operating expense would be practically nothing. It would, however, require a fairly good mechanic to install it properly. About the only precaution is to have a separate steam line direct from the boiler to operate the traps, because if the connection is taken off the heating line, even back of the reducing valve, the traps are apt to hang up at times.

69—Waste Pipes for Corrosive Acids.

Question: In a certain schoolhouse installation where there is a chemical laboratory for students' use, standard lead wastes and cast-iron pipe have been used for draining the chemical wastes. No thought has been given by the architect to the fact that chemicals have a very corrosive action on these materials. Is there any practical way of floating in a coating on the piping from the sink drains so as to protect the pipes against corrosion, or do you think it is necessary to coat them? If not, can you cite experiences of others who have been confronted with this situation? Do you know of any cases on record as to how soon deterioration has rendered the wastes defective?

Answer: Lead wastes would probably last fairly well, as dilute acids have slight action on lead. Iron, however, is rapidly attacked by dilute acids while being practically immune from concentrated acids. Lead is used largely for the manufacture of sulphuric acid.

Black tin pipes have been used for this purpose, but any metal of this class is exceedingly expensive and inasmuch as different kinds of chemicals are apt to be used it would be rather hard to name one material that some of the chemicals would not attack. In view of all the conditions it would probably be best to leave the lead pipes as they are and renew them when worn out. This is the policy usually followed in boiler feed piping. Such piping was formerly made of heavy brass, but now most power plants use extra heavy iron and replace the pipes when necessary.

The writer does not know of any coating that could be used that would stand as well as the metal. Monel metal has been used for fans where gases containing corrosive chemicals are handled, but the writer has never heard of its being used for wastes.

LEGAL DECISIONS

"Doing Business" in State.

The Michigan Supreme Court holds that a contract by a foreign corporation, which has not complied with the corporation laws, for the sale of superheaters requiring that the corporation not only manufacture and ship, but also erect them in the buyer's plant in the state is invalid as a contract for doing business in the state, unless the foreign corporation suing on the contract can prove that the installation was, because of some peculiar quality of the apparatus, essential to the making of the sale.—Power Specialty Co. vs. Michigan Power Co., 157 N. W. 408.

Rates for Domestic Heating Appliances.

An electric lighting and power company was ordered by the Oregon Railroad Commission to amend its rates so as to permit domestic heating appliances and small motors not exceeding 2 k.w. total connected load to be used as a part of the installation under its regular business or schedule rates, it appearing that the company's schedules for power rates had formerly been applied to current consumed by such small motors and heating appliances, which schedules were based on the maximum demand of the consumer with a minimum charge of $1.00 per kilwatt of maximum demand, but which provided that no maximum charge of less than $2.00 would be considered.—Hubbard Creamery Co. vs. Molalla Electric Co.

Reasonable Rates for Heating Service.

The Idaho Commission holds that the fact that a flat rate for electricity for water heaters amounts only to about one-fourth of the cost of the service, if the consumers use their heaters twenty-four hours a day on high, is not sufficient to overcome the presumption of reasonabless attaching to a voluntarily established rate, particularly where the heating service is furnished in connection with electric service for cooking. Such service is very profitable, and it appears that some of the patrons use their heaters part of the day on high, part of the day on medium, part of the day on low, and part of the time shut off altogether, and the company although it has something like 2,300 lighting consumers, had secured, after much advertising and soliciting, only about 30 water heating consumers and where it further appeared that the company has abundance of surplus power even when the peak load is on. The Commission was also of the opinion that it did not have jurisdiction of the complaint against the rates, since it was made by a competing utility, and not by one of the parties designated in the public utilities act, but it preferred to decide the case upon the merits rather than on a jurisdictional question.—Pocatello Gas & Power Co. vs. Southern Idaho Water Power Co.

Application of Money Derived from Contract.

The constructors of a heating plant in a school building applied money received from the contractor with instructions as to its application to unsecured debt, in good faith, and without knowledge of the source of the money, which was derived from a contract for the performance of which the contractor had furnished surety. In an action on the bond it was held that the contractors of the heating plant were entitled to have their appropriation remain undisturbed and to hold the surety for any deficiency, although as between them and the surety there was but one debt the application of the payments derived from the contract being one of the hazards the surety assumed. The question of the plaintiff's want of knowledge of the source of the money and good faith in making the appropriation to the payment of the unsecured debt being controlling issues, and the evidence thereon being conflicting it was held that the trial court did not abuse its discretion in granting the plaintiff a new trial, after judgment for the defendant, upon the ground of insufficiency of evidence.—B. F. Sturtevant Co. vs. Fidelity & Deposit Co. (Wash.), 158 Pac. 740.

CORRESPONDENCE

Heating With Exhaust Steam from Steam Hammers.

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to Reply No. 66 in the October issue of THE HEATING AND VENTILATING MAGAZINE, there is one point that I would like to have explained and that is the matter of rates. Assuming that exhaust steam is used entirely for heating purposes, with suitable meters on the condensation, which is returning through a vacuum system, how is the actual charge arrived at?

Pontiac, Mich. F. L. V.

As far as selling heat on the B.T.U. basis or by pounds of condensation is concerned, the units are interchangeable, so that it makes little difference which method is used. In rendering bills for heat, the cost and profit should be included, as with any other commodity, and a unit of measure used which is easily understood by the customer.

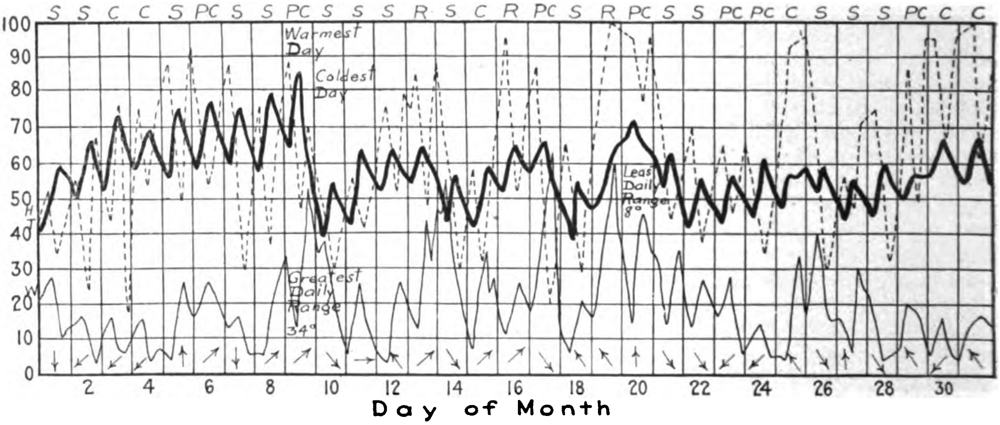
The common unit of measure would naturally be that in which the dial of the meter is calibrated. This is generally "pounds of steam condensed" because that is what the meter actually records. In using a condensasation meter care should be taken to set it properly before making the connections and also to test it in advance for accuracy. If not properly adjusted, this type of meter is apt to read "wild."

As far as rates are concerned, these, of course, will be determined by the costs, and in this connection it should not be assumed that because there is a surplus of exhaust steam at times the heating will cost nothing. Heating will probably be required at many times when there is no exhaust steam or insufficient, and live steam will have to be provided. From the writer's experience, 30 cents per 1000 lbs. of steam is about the cost in most places and a selling price of 50 cents per 1000 lbs. yields a fair profit. This is about a rate of $7.00 per ton of coal to the consumer, but there is no expense for boilers and labor of attendants.

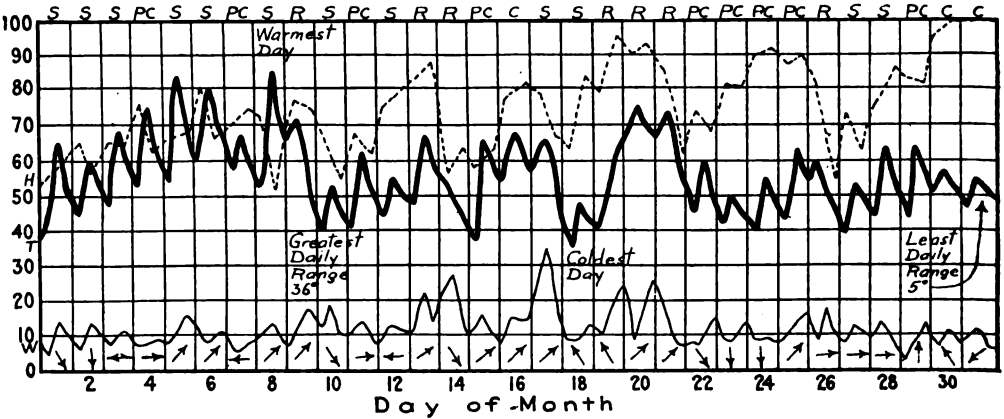
The Weather for October, 1916.

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F	84	84	86	87	86
Date of highest temperature	9	8	8	5	7
Lowest temperature, degrees F	39	36	33	35	30
Date of lowest temperature	10	18	23	26	21
Greatest daily range, degrees F	34	36	35	31	27
Date of greatest daily range	9	9	3	8	22
Least daily range, degrees F	8	5	3	3	7
Date of least daily range	20	31	21	21	15
Normal temperature for month, degrees F	57.2	56	55	54.4	59.2
Normal mean temp. for month, deg. F	55.6	52.3	54.9	53.2	58.4
Total rainfall, inches	0.63	0.94	2.31	3.88	1.64
Normal precipitation this month, inches	3.71	3.86	2.36	2.55	.41
Total wind movement, miles	11804	7489	7311	10208	9575
Average hourly wind velocity, miles	15.9	10.1	9.8	13.7	12.9
Prevailing direction of wind	N. W.	S. W.	W.	S. W.	S.
Number of clear days	15	14	16	*18	16
Number of partly cloudy days	7	9	4	6	8
Number of cloudy days	9	8	11	7	7
Number of days on which rain fell	4	7	10	*16	8

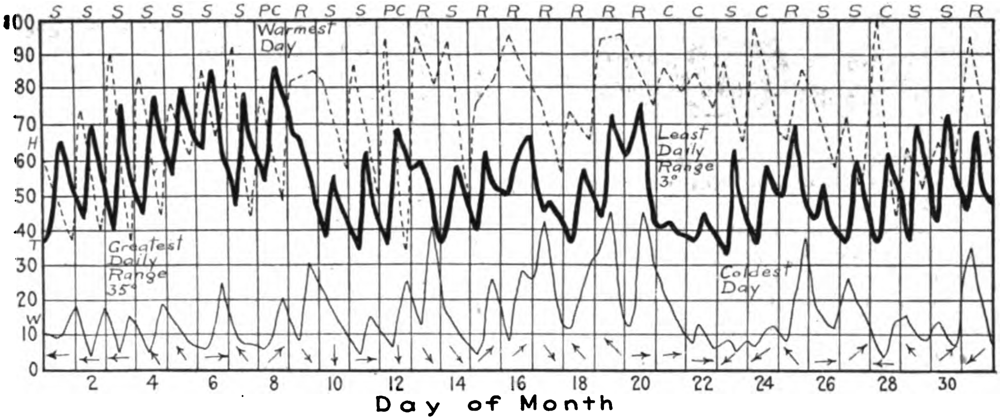
*Although 0.01 in. or more of rain fell on 16 days during the month, there were 18 days that were classed as clear, having 30% or less of cloudiness.



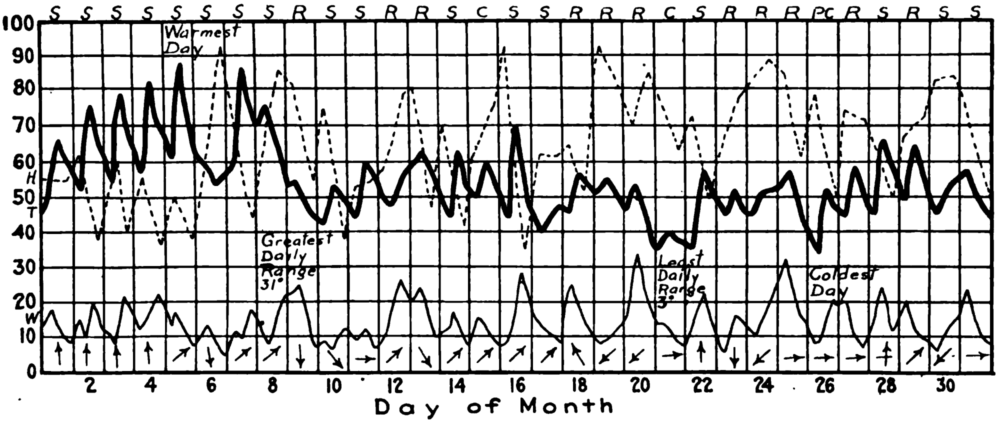
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1916.
(Hourly Observations of the Relative Humidity are Plotted on this Chart.)



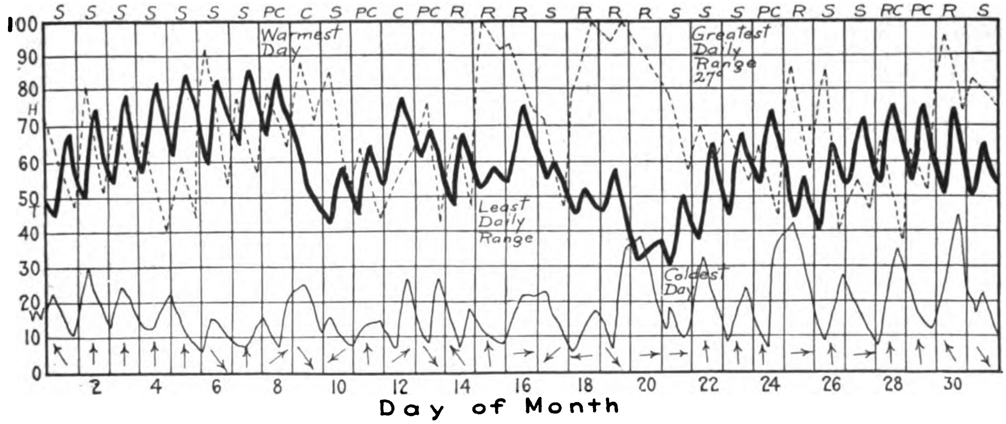
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1916.



RECORD OF THE WEATHER IN PITTSBURGH FOR OCTOBER, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Discusses New Type of Vacuum Heating System.

What is described as a "one-pipe down-feed vacuum heating system, eliminating traps, return valves and air valves on individual radiators," was the subject of an address delivered by Charles R. Ball, the inventor of the system, at the November meeting of the New York Chapter. The meeting was in charge of a special committee headed by A. M. Feldman, chairman, who was handed the gavel by President Arthur Ritter after the preliminary business had been disposed of. This included an announcement that the executive committee had appointed A. S. Armagnac to act as chairman of the chapter's entertainment committee in connection with the annual meeting of the heating engineers' society, January 16-18, 1917.

Before introducing Mr. Ball, Mr. Feldman gave an account of the development of the steam loop and the first return trap, invented by the late James H. Blessing, of Albany.

He then introduced Mr. Ball as one of the pioneers in the vacuum steam heating field whose inventions have contributed much to the advance of this art.

Mr. Ball began his address by stating that the air line and "tail end" vacuum systems constitute a very old art, in which the real drama is connected with the "tail end" system. It is the general impression he said, that the beginning of the art of vacuum heating practice was concurrent with the Williames patent (1882). He pointed out, however, that the use of the Blessings trap dates from 1870.

The Williames patent, both in drawings and specifications, refers to both a fan or pump for the exhausting apparatus, to extract the air only and receive the condensation in a tank or hot well. It shows on steam and return connections just the plain globe or angle pattern valves and refers to a cold water spray to condense vapors and cool the air, and also to pressure steam to force a circulation where no exhaust is available. All claims of this patent, segregated from the drawings, would apply to the surface condenser in common use at the time, all in accord with later court decisions.

It was the irony of circumstance, continued Mr. Ball, that the first installations of this system were made in factories, where there were large cooling coils of 1-in. pipe, from 125 to 150 ft. long, with four to ten pipes assembled. Formerly pressure steam direct from the boiler, throttled down at the inlet valve, had been used, blowing through a return, with a trap delivering to a hot well for return by feed pump. The inducement for revision then as now was the conversion of the exhaust without back pressure, and such results were obtained.

It is easily seen that the long travel of the steam and the relation of the areas of the small pipes to their surface enabled a most complete condensation of the exhaust some distance before it reached the end of the coils and that a considerable cooling of the condensation itself took place in the coils, thus eliminating all flashing and other troubles that arise from condensation containing too much sensible heat. Later on, however, it was attempted to use this system in buildings containing radiators in small units, and in those days, with solid bases of large areas and tubes superimposed, the vacuum impulse drew the steam through with great velocity, causing a short circuit to the return pipes and connections.

Traps of all kinds were in general use in those days, also the common air valve with an expansion member, so we made a diminutive trap to work thermostatically and applied it to the return outlet. The catalogue phrasing being "to allow the free escape of water and air, but prevent the wasteful escape of the vehicle," compelled us to acquire the Hall patent. In arranging for an initial vacuum sufficient to circulate the remote radiators, our velocities became so great that the condensation reached the pump with so much sensible heat that it flashed, that is, our condenser did not condense, so we put in a jet.

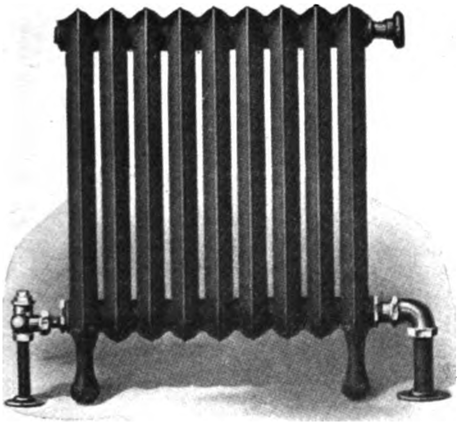
The hand adjustment of the steam valve to the pump and that to the jet could not be dependably arranged to preserve at all times the vacuum required. The pump would race with injury to itself and the jet would either be excessive or not sufficient, in which case the flashing lowered the amount of vacuum. The next step, therefore, was the vacuum controller, that compelled us to acquire the Hussey & McCann patent.

FEATURE OF THE VACUUM HEATING SYSTEM.

After a further discussion of the development of the art, Mr. Ball took up the description of his new system which is called the "Pres-Vac" system of steam heating. In this system use is made of the hot-water type of radiator. The first section is closed at the bottom with a solid nipple to shunt the steam up the first section to the controlling factional packless insert valve. The runout branch to the radiators is a single pipe in which the first nipple has areas suitable for the steam supply and the return, underneath the steam, of the condensation back to the riser. From the drop tee noted, the pipe runs to and connects with the check on the return outlet.

On the riser below all surfaces is placed an extra heavy socket tapped for the thermo, and in the spring piece is inserted a swing check, the arrangement of which was shown. At the extreme end of the main return delivering to receiver of boiler feed pump, is a fitting termed A. R. Co. 525. The function of this fitting is to relieve at a few ounces pressure, close upon steam contact, and admit no re-entrance of air when the pressures are below atmosphere.

The circulation of steam through this system is downwards. The initial procedure, whether for tests or temporary heat, is to use such an initial pressure as will blow out the air through the fitting 525. The vacuum pump will be running, not necessarily for assisting the circulation, but preferably to test the adjustment of the thermos. Operating so, it is obvious that the air will be relieved quickly, and the steam will soon reach the thermos which, in turn, will close, allowing the vacuum to cut out the pump through the controller, with the preferred adjustment of 22 in. of vacuum.



ASSEMBLY OF INSERT VALVE, RADIATOR AND ADJUSTABLE CHECK USED IN "PRES-VAC" SYSTEM OF STEAM HEATING.

Coursing downward, as each riser tee is reached, an equilibrium will take place in the connection and some air will relieve at the check. Steam will flow into the void and condense, closing the check until another equilibrium occurs. The recurrence reciprocally of this function will fill the radiator with steam to the base, the air and consequent condensation falling to the terminal points. At this point if the steam valve to any radiator should be closed, upon opening it the circulation will be affected as explained.

In order to meet varying ideas as to proper temperatures for comfort, the initial conditions must be such that those requiring less heat can get it by manipulating the fractional inlet valve. As these differing fractional volumes condense in the radiator, the lesser pressures close the checks accompanied by an upbuild of the water proportionately to the adjustment for the lesser steam volume. Upon opening the valve again, the retained water falls and causes a void, much after the manner of producing a barometric vacuum, into which the steam flows. This, according to Mr. Ball, is a better function than that in some vapor systems which provide that the air shall again enter under fractional uses, because the further relief of that air requires a pressure slightly in excess of that of the atmosphere.

One of the important features of this system, as explained by Mr. Ball, is its adaptability for operation under a wide range of pressures, making it possible to modulate the temperatures and prevent overheating by control of the initial pressure at its source. The regulation of the initial pressure may be obtained by the operation of a single valve, Mr. Ball explaining in detail how this is accomplished.

Regarding the function of the vacuum pump used with this system Mr. Ball emphasized the point that in no way and at no time does this pump operate to cause or maintain the circulation. After discharging the air at the fitting 525, by the few ounces of pressure required, and after that fixture closes by steam contact, the system could be operated indefinitely and at any desired pressure. The pump is a dry air pump and as such must have a small amount of water to seal the valves. The air separating tank is used to furnish the sealing water. Each discharge of the pump delivers this water again to the tank, to be used continuously as described.

The importance of having the riser entirely free of air at all times and filled with vapor and steam to enable the air to fall by gravity to the terminal points is the prime reason for the use of this pump. It is also intended for use when the system is operating at and considerably below atmospheric pressure, and at times when it would not be convenient to raise the pressure to that required for a mechanical air relief at fitting 525. Obviously, this can be a very small pump.

Vapor Heating Discussed by Illinois Chapter.

Vapor heating, with special reference to its use in central station heating work, was the subject of a talk by Lloyd Howell, of the American District Steam Company, given at the November meeting of the Illinois Chapter.

This meeting was held November 13 at the Engineers' Club, in Chicago. The address followed a dinner and smoker, with President Fred W. Powers in the chair. The treasurer, August Kehm, reported a balance of $311.

Mr. Howell, who was then called upon, gave his hearers some interesting facts as to the methods used in central station heating work; including the use of vapor heating. The usual central station heating plant, he said, delivers steam through the street mains at a pressure fluctuating from 1 to 5 lbs., depending on the weather. Where the connection is made for the supply piping system for a building, a simple pressure regulating valve is used and a U-tube mercury gauge to determine the pressure on the low side of the valve. The customary setting for the delivery is 6 oz.

Mr. Howell said that it was customary to furnish 25% surplus radiation in buildings using central heating service, the extra radiation being used to remove as much heat as possible from the condensation. As a result the temperature of the condensation is about 90° F. and often lower.

Over fifty members and guests attended the meeting.

Eastern Pennsylvania Chapter.

"Open Air Schoolrooms" was the topic of the evening at the November meeting of the Eastern Pennsylvania Chapter, which was held at the Engineers' Club, November 9. The principal speaker was Dr. Walter Roach, of the Philadelphia Bureau of Health.

After outlining the necessity for open air schoolrooms and the advantages to be derived from their use, Dr. Roach illustrated the work being done in Philadelphia in this direction by means of motion pictures. An interesting discussion followed the presentation of the paper. Among the chapter's guests were Secretary C. W. Obert of the heating engineers' society and James A. Donnelly, of New York.

Michigan Chapter Gets Furnace Heating Data.

A carefully-prepared paper on furnace heating was presented at the November meeting of the Michigan Chapter which was held at the Fellowcraft Club, Detroit, November 13. The paper was presented by J. M. McHenry and included data regarding results of tests conducted by Messrs. McHenry and Davenport at the Detroit Stove Works. The paper was generally discussed.

The meeting was largely attended, President John R. Allen being in the chair. Action was taken on the question of the control by the city of chimneys and flues used for heating apparatus, the chairman appointing the following committee to confer with James C. McCabe, chief boiler inspector of Detroit: F. K. Boomhower, R. S. M. Wilde, E. L. Downs and E. J. Lomasney.

J. E. Degan was appointed to take charge of the trip of the members of the Michigan Chapter to the annual meeting of the society in New York in January

The subject for the December meeting which was scheduled for December 11, was "Direct and Indirect Heating Systems."

NATIONAL DISTRICT HEATING ASSOCIATION

Dates Selected for 1917 Convention.

The ninth annual convention of the National District Heating Association, it is announced, will be held in Detroit, Mich., June 12-15, 1917. Headquarters will be at the Hotel Pontchartrain. The announcement is issued by President Byron T. Gifford and Secretary D. L. Gaskill "to the members of the National District Heating Association and all interested in district heating."

◆

American Society of Mechanical Engineers.

A large attendance and full discussions marked the annual meeting of The American Society of Mechanical Engineers, which was held in New York, December 6-9. In addition to the general sessions there were industrial safety, textile, machine shop, valuation, gas power, railroad and steam boiler sessions. During the Wednesday session, December 6, a paper was presented of general interest to the heating trade on "The Testing of House-Heating Boilers," by L. P. Breckenridge and D. B. Prentice. This paper attracted considerable discussion which will be presented in a later issue. The paper itself, as well as another paper read at the Wednesday afternoon (textile) session by Arthur N. Sheldon on "Heat Transmission Through Various Types of Sash," will be found on other pages of this issue.

The election of officers resulted as follows: President, Ira N. Hollis, Worcester, Mass.; vice-presidents (for two years), Charles H. Benjamin, Lafayette, Ind.; Arthur M. Greene, Jr., Troy, N. Y.; Charles

T. Plunkett, Adams, Mass.; managers (for three years): Robert H. Fernald, Philadelphia, Pa.; William B. Gregory, New Orleans, La.; C. R. Weymouth, Berkeley, Cal.; treasurer: William H. Wiley, New York.

◆

How to Sort and Preserve Technical Periodical Literature.

A salient feature of the Detroit Edison Company library, says a writer in *Special Libraries,* is what is termed a technical periodical service. In meeting individual members of the organization, I found a general sentiment among them of their sheer inability to keep informed thoroughly of the current trend of their particular line of interest and a keen enthusiasm for any method which would give them the assurance that their interests were being watched and items of special importance brought to their attention. In this connection I have built up a schedule of the interests of the various individuals of the company, and through the company publication have announced that upon request this service will be extended to any person who will thereby receive automatically such articles as interest him whenever they appear. This service brings directly to his desk the gleanings of one hundred thirty picked journals. Individuals may have their names entered to the mailing list to receive regularly those journals which they particularly wish to examine as issued; these are sent to their desks, if desired, with the request that they be returned at a specified date, depending upon the demand for the journal. A date signal is placed on the card which carries the charge and prevents it from being held unduly long on any desk.

THE PRESERVATION OF ARTICLES OF VALUE.

The matter of preserving published articles is one which demands thoughtful treatment. I personally examine all of the journals, including those of French and German publication, that come into the library. In estimating an article I consider whether it is of remote or immediate interest. In the case of the article which deals with a subject that the company might be interested in at some distant time, the time necessary to look it up would be of negligible concern to the person requesting it. Articles of this type are readily available through the several periodical indexes, and a business library does well to avoid this unnecessary duplication of effort. On the other hand, if the article is of such a character as to make it desirable to place it at the disposition of any individual at a moment's notice, a card is placed in the catalog bearing the citation. The card used for this purpose is of a special form, drawn up for the purpose of reducing the amount of typing to a minimum.

TITLE ....
AUTHOR ....
JOURNAL ....
Date........ 19... Page...... Vol........
Comparative ..Descriptive..Experimental..
Historical... Mathematical... Practical...
Illustrations.. Tables.. Curves..

After considering the article from this angle, the particular article is directed to the list of persons which the schedule shows are interested. Frequently, if it is an article of general interest, it is directed to a responsible person with the request that it be circulated to all those in his department who may be interested. In this connection I might mention the point that valuable specific items are frequently to be found in articles which are general in their treatment and which in many cases are not analyzed in the regular periodical indexes; such data should of course be noted in the library catalog.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HOT-WATER HEATING

Hot-Water Heating at Plant of the Crane Co., Chicago. Thomas Wilson. Ills. 2000 w. Pwr—Sept. 12, 1916. Serial, 1st part. Modern system of seven circuits to care for 600,000 sq. ft. of radiation in 49 buildings. 20c.

A Successful Hot Water Heating System. J. C. Hawkins. Ills. 2,000 w. P E, C—Oct. 1, 1916. Scheme for heating office building. 20c.

◆

Warm Air Heating and Sheet Metal Journal is the new title of the *Sheet Metal Contractor's Journal.* This magazine was formerly published by Edwin L. Seabrook, secretary of the National Association of Sheet Metal Contractors, but has recently been taken over by the association itself and will be developed as strictly an association organ, the purpose being to make the journal the business magazine of the sheet metal trade.

Purification of the Air by Electricity.

A scheme for removing dust and germs from the air, known as electrical precipitation, has recently been perfected in America, based on an idea originating in Germany. Electrical precipitation it is known, takes place on an enormous scale in Nature, the downfall of rain and with it dust, after a flash of lightning, being a familiar example.

Electrical precipitation is described by a writer in the Electrical Review as a mode of charging rust and the finest atoms of matter, whether mineral or vegetable, with electricity, and of causing them to fall or be precipitated upon a plate or vessel or tank, as it may be called, which is known as the precipitator. It is a kind of giant vacuum cleaner. The electric current is the agent of this precipitation. By this force each grain of dust or matter is charged with the same kind of electricity, which sets each particle in rapid motion and causes the whole mass of these small and even tiny atoms to concentrate on the precipitator, which thus collects them in a layer. In this way the dust of a room, a theatre, a railway car or factory, and even the open air, is made to settle upon a surface or in a series of tubes and pipes. These precipitators have been installed in various buildings.

They pay a good return on the investment of money required. For example, in ventilating modern public buildings and uptodate factory buildings it is considered desirable to control the temperature and humidity of the air and remove all dust, bacteria or germs. In one recent installation it was found that by circulating a large quantity of air by electric currents in a closed system, by thus removing the dust and moisture by electrical precipitation, the saving of steam which would have been required to dispel the moisture and the dirt by heat in cold weather paid a high return on the money spent.

This method is obviously of great value in sanitary cleaning. The necessary plant appears to be fairly easy to use for purifying the air either of rooms or of open spaces. Some way of cleaning the places where the germs of epidemic diseases collect and multiply is urgently required. The germs of infantile paralysis, for instance are carried in ships, in trains, in subways; they grow in tenements on garbage and refuse, and they seem to be especially active in summer, when dust is plentiful and is blown about in the streets and into houses through the windows. These germs are fatally likely to exist in the waste products of the human body, in the secretions of the mouth and nose, and any fight to a finish with such enemies must require all our resources. We are all agreed that such measures are necessary, but we are curiously inconsistent in the way we neglect the engineering side of these problems.

Vent Hoods of the Internal Cone Type.

Two interesting types of vent hoods, with internal cones, are illustrated herewith, the hood shown in Fig. 1 being designed for use when exposed above the roof, that shown by Fig. 2 for use when installed in a cupola. Because of their exposure to the elements, these hoods should be constructed of galvanized iron of two gauges heavier than ordinary sheet metal work which is installed of equal size, though preferably these should be of 20 oz. copper (30 oz. in large sizes), with copper rivets used in making up the copper work.

The inner cone should be larger in diameter than its connection to the duct work, in order to prevent rain or melted snow from entering the ventilation system. The ¾-in. lipped edge, as shown in the sketches, is used to direct the water directly downward, thus preventing it from traveling inward to the lower apex of the inner cone. With a cone of the type shown in Fig. 2 it is necessary to install a 1¼-in. or 1½-in. galvanized iron drain line connecting from two points, as shown, and extended from these points to the nearest inside rain water conductor. Both drains of smaller size and those discharging directly open above the roof are liable to freeze solid. Where carried inside they are somewhat protected from freezing and are also heated by the exhausted air. With a cone of the type

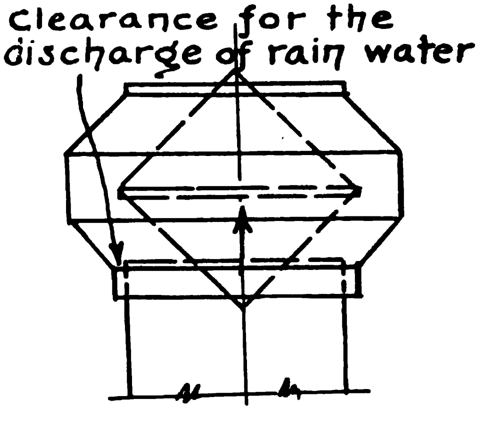


FIG. 1.—VENT HOOD DESIGNED FOR USE WHEN EXPOSED ABOVE ROOF.

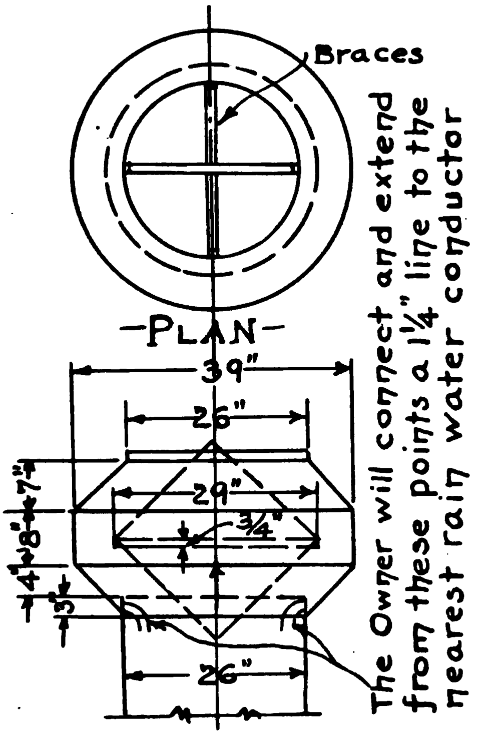

Braces
-PLAN-
39"
26"
29"
3/4"
2"
7"
8"
4"
3"
26"
The Owner will connect and extend from these points a 1¼" line to the nearest rain water conductor

FIG. 2.—DESIGN OF VENT HOOD FOR USE IN A CUPOLA.

shown in Fig. 1, the discharge of entering water may be effected, as shown, by a clearance around its entire circumference.

The clearance between the inner and outer cones should be of a free area, equivalent to their connection to the system. In some systems, though the exhaust fan is run intermittently, it is nevertheless desirable that the air be exhausted for ventilation purposes by gravity to as great an extent as possible from the various rooms to which connections are made. In such cases the free area through the cone, together with its connection, should be of a greater area. The sloping sides of the cone are constructed at angles of 45°, and this, together with the required free area and greater diameter of the inner cone, as previously explained, determine the dimensions of the vent hood. The hood should be braced, as shown in plan.

Should the vent hood be used in connection with the exhaust of vitiated air from an abattoir, it is necessary that the top thereof be completely covered with a 14 to the inch square mesh copper wire screen, set in a removable frame. This prevents the entrance of flies, and for the same reason it is best to use a vent hood of the type shown in Fig. 2, which eliminates the opening around its circumference for the discharge of water, as shown in Fig. 1.

◆

The Application of Gas to Steam Boilers.

That the gas interests are rapidly waking up to the opportunities in connection with gas-fired steam boilers, especially in the industrial field, is demonstrated by the recent publication of Industrial Fuel Reference Book No. 3, which is entirely devoted to this subject. The book is published by the National Commercial Gas Association, 61 Broadway, New York. The information has been compiled with the definite view of giving the gas appliance salesmen information necessary for the sale, actual installation and upkeep of gas-fired steam boilers. Some of the better-known makes are described, including the Ofeldt, Kane, Schmitt, Automatic, Economy, Triumph, Electric Weld, Freymark and Scientific boilers.

Under "Applications of the Gas-Fired Steam Boiler," it is stated that these applications are of an exceedingly diverse and extended nature. They are classified as high pressure where the steam pressure exceeds 15 lbs., per square inch, and low pressure where below this figure. Another method of division is to designate the systems as open or closed. Practically every industry, it is stated, offers opportunities for the use of the gas-fired boiler.

Under "Advantages" is mentioned first the efficiency which, it is stated, is considerably higher than that of the boiler using solid fuel. Cleanliness is also emphasized as well as the smaller space taken up by the gas-fired boiler. In addition the gas boiler can be set near the work, which is often on the upper story of a building, where it may be inconvenient to supply coal and remove ashes. This means a saving in expense of installing steam pipe and a saving in fuel, because the radiation from long runs of steam pipe is eliminated.

The labor saved is also important, as when working on a closed system, for instance, or with an automatic feed water regulator very little attention is required, and the services of one man can often be saved, besides the handling of the fuel and ashes.

Gas-fired boilers, it is pointed out, are equipped with automatic devices which cut down the gas supply when a predetermined steam pressure is reached. This means constant pressure, besides a saving in fuel.

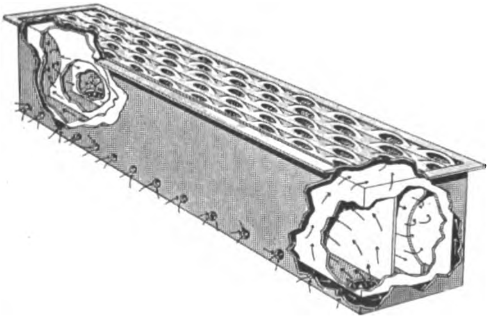
Still another point brought out is that steam can be very quickly raised in a steam boiler, while the application of the boiler to intermittent uses of steam is one of its greatest advantages. Finally, the gas boiler is exceedingly well protected against accident, being practically fool-proof in this respect.

The ensuing pages contain some interesting matter in the way of practical questions and answers regarding steam boilers, feed water problems and steam pumps. A list is also given of some of the uses for gas-fired steam boilers the book concluding with descriptions of various accessories, such as gas regulators, water feeders, including pumps and injectors and steam traps. Size 6x9 in. Pp. 119. Price 50 cents.

NEW DEVICES

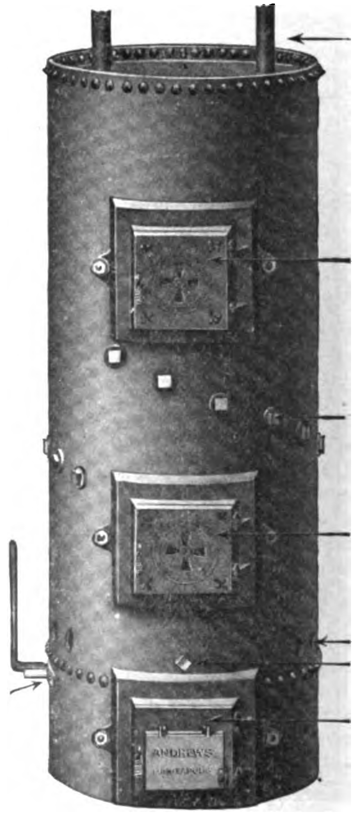
Blackwell Auto Exhaust Heater.

A new exhaust heater for automobiles which is designed to take the place of the muffler, has been brought out by the Dayton Welding Co., Dayton, O. It is intended to be placed between the front and rear seats of the five or seven-passenger car. The heater is 24 in. long by 4¼ x 4¼ in. It is made of heavy-gauge pressed steel, every seam and joint being welded, to make it fume-proof. The heater is constructed of two steel boxes. The inner box has three partitions and the heat travels 6 ft. on the inside of the inner box before being discharged. The outer box is made with ½-in. air space on all sides and is covered on the inside with asbestos, cemented to the inside of the outer boxing. This leaves ⅜-in. air space next to the inside box which communicates with holes on the front bottom edge of heater, allowing the fresh air to pass in and forcing the hot air out into the car.

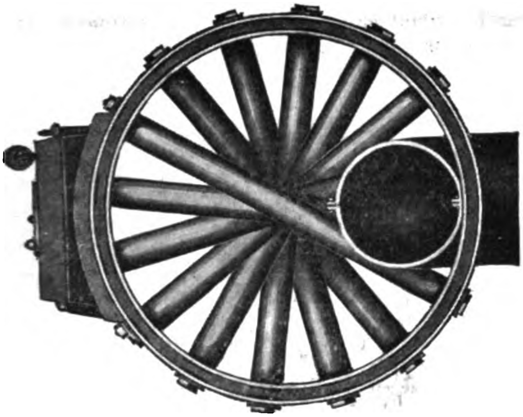


BLACKWELL AUTO EXHAUST HEATER.

Andrews Garbage Burner and Water Tank Heater, for apartments, hotels, hospitals and residences, has been brought out by Andrews, Minneapolis, Minn. The garbage is fed in at the upper door and is dried and burned as it travels down the brass spiral stairway grate, made of brass water tubes. The oil and grease in the garbage give off an intense heat as they burn, which is utilized in heating the water. It is stated that from 30% to 50% of the fuel can be saved over the amount required with an ordinary tank heater. The heater itself occupies a floor space from 22 in. to 34 in. diameter, depending on the size selected. The brass spiral stairway grate is the exclusive feature of this garbage burner and heater. It is arranged with a by-pass for the free escape of smoke, moisture and gases from fresh garbage.



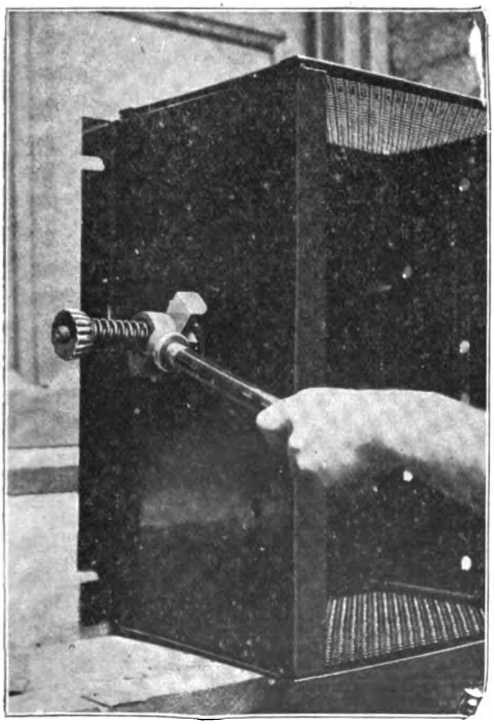
ANDREWS GARBAGE BURNER.



TOP SECTIONAL VIEW SHOWING LARGE HEATING SURFACE IN BRASS WATER TUBE SPIRAL STAIRWAY GRATE.

A Handy-Operating Cutter.

The usual way for making an additional hole in a cabinet for accommodating a piece of conduit or for making a hole in metal lockers, has been a source of considerable trouble. The accompanying illustration shows a new, easily-operated tool, invented by a Milwaukee man, Mr. Bach. This device can be used for cutting all sorts of metal, fibre and slate, and can be adjusted so as to cut holes of various sizes with little effort. To use the tool, a pilot hole is first drilled through the material and through this is passed the stud. A flange nut is then secured on the opposite side of the stud and a ratchet wrench used to cut the hole. This cutter is known as the "Jiffy" and is being manufactured by the Universal Tool and Appliance Co., Milwaukee, Wis.



SHOWING USE OF NEW "JIFFY" CUTTER.

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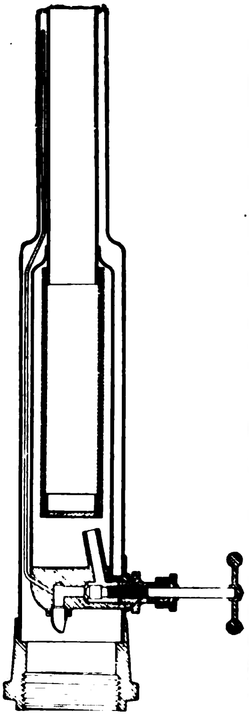
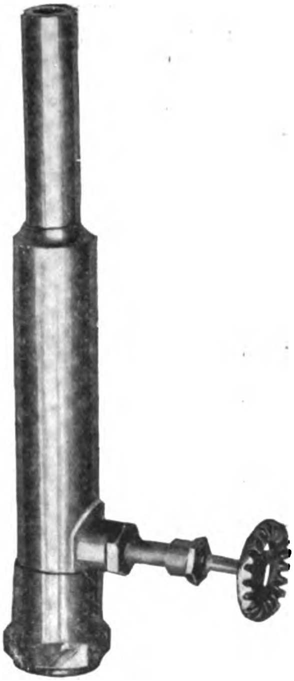
Trade Literature.

STEAMO AND VAPO AIR MOISTENERS, for steam, vapor and vacuum heating systems, are featured in a new catalogue issued by the Air Moistener Co., 28 North Market Street, Chicago, Ill. These devices are designed to discharge steam or vapor silently in a dry state directly from the steam pipe or radiator into the room. The point is emphasized that there is no question of their working as the operation is not hidden, the issue of the moisture and its absorption occurring in plain sight. The Steamo air moisteners are for use with the



INTERNAL VIEW SINGLE PIPE TYPE.



SINGLE PIPE TYPE.

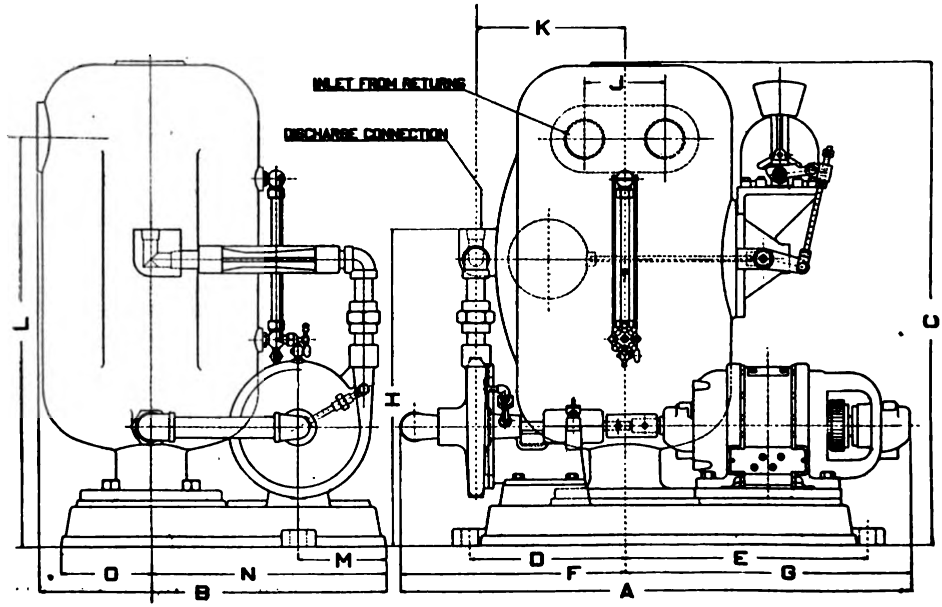
ordinary steam systems, and the Vapo moistener for vapor and vacuum systems. Neither device can be used with hot water heat. The full line includes the radiator type, single-pipe type, riser type and double pipe type, each in two or three sizes. Directions are also included for connecting and operating each type. Size 5½ x 8½ in. Pp. 12.

A Day's Work, comprising "a series of disjointed talks to the employees" of the United States Radiator Corporation, Detroit, Mich., is a booklet well worth reading. It is intended to convey the code of efficiency which the management considers essential to the successful conduct of its business. Size 3½ x 6 in. (standard). Pp. 20.

Advance Condensation Pump and Receiver, automatic and motor driven, made in two types, is an interesting product of the Advance Pump and Compressor Co., Battle Creek, Mich., and described in a recently-issued catalogue. This outfit includes an over-hung centrifugal pump, motor-driven, mounted on the same cast-iron base plate with the vertical cast-iron receiver tank, and has automatic switch control and non-overloading safety device. The discharge of the pump is connected through a pipe to suitable boss cast on the receiver tank, and the suction inlet of the pump is also connected by piping to the receiver. One of the principal points mentioned for this apparatus is that the motor and pump cannot get out of line. The bulletin (No. 205) includes detailed specifications and there is also a table of standard sizes for the two styles, under four different conditions of service. Size 6 x 9 in. (standard). Pp. 8.

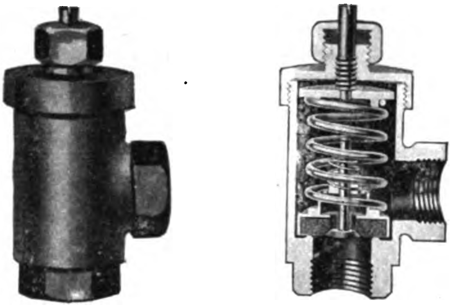
ADVANCE CONDENSATION PUMP AND RECEIVER.

Nefco Heating Specialties, including the Nefco automatic vacuum-vapor heating system, Nefco radiator regulating valve and Nefco heat generator, are featured in a recent catalogue issued by the N. E. Frost Co., 231 Insurance Exchange, Chicago, Ill. The Nefco heat generator is for use with hot water heating systems. It can be placed anywhere on the line to the expansion tank and is set against a 10-lb. pressure, so that it operates to confine the water in the system until a pressure of 10 lbs. is created above the natural pressure of the water in

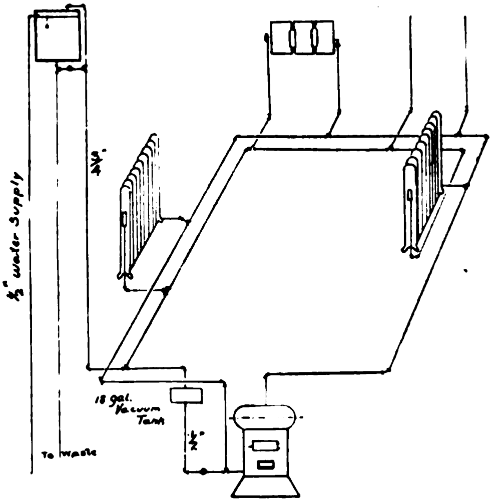


CONSTRUCTION OF ADVANCE CONDENSATION PUMP AND RECEIVER.

the system. The more rapid circulation obtained permits the use of one size smaller radiator valves and connections from main than with the open-tank system. The device itself is made of brass. The springs are of phosphor bronze. Although adjusted to operate at 10 lbs. pressure, these generators can be readily set for 25 lbs. pressure for the tank-in-basement system. Size 5 x 7¼ in. Pp. 14.



EXTERIOR AND SECTIONAL VIEW OF THE "NEFCO" HEAT REGULATOR.



NEFCO AUTOMATIC SYSTEM APPLIED TO HEATING PLANT.

THE BEIGHLEE SYSTEM, COMPENSATED, is the title of a new bulletin issued by the Beighlee Electric Co., Cleveland, O., devoted to "the pyrometer that has set a new standard." The Beighlee pyrometer system is the invention of H. E. Beighlee and, it is stated, will be found to successfully overcome the errors of the ordinary types of pyrometers, such as the temperature coefficient error, the cold junction error and the lead resistance error. The operation of the Beighlee system is described at length, the text being accompanied by many illustrations. Size 6¾ x 10 in. Pp. 28.

NATIONAL TUBE CO., Pittsburgh, Pa., is sending out Correction Sheet No. 2, applying to Catalogue J-1915, devoted to the Kewanee products of the company. The changes refer principally to the sizes of close nipples, a new pattern of No. 6 boiler coupling with union, additional sizes of National flange unions, and new data on National spring plug cocks.

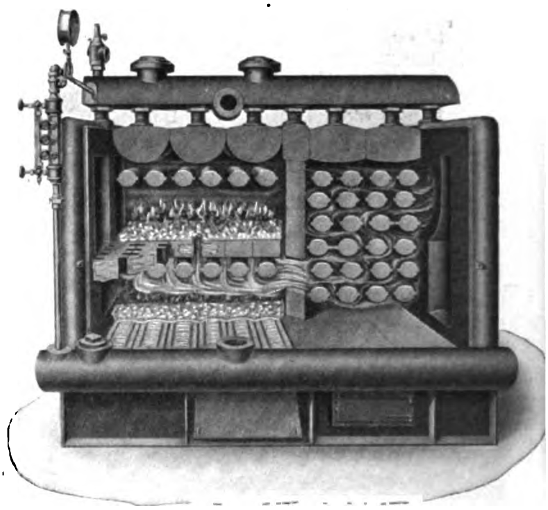
CRAWFORD FURNACES, 200 SERIES, for warm air heating, are a new and unique product of the Walker & Pratt Mfg. Co., Boston, Mass., which are the subject of a special catalogue. The most prominent feature of this heater is the single damper which regulates the ashpit draft, the smokepipe opening, as well as the smokepipe check from the cellar. A single flap revolving inside the damper shuts and opens the four openings in exactly the proper proportion. The furnace is not a down-draft furnace in any sense of the word and cannot be used as such, although the presence of a pipe on the side of the ashpit tends to give that impression. The dome is cast-iron without any openings or joints. The cleanout arm is on one side and the smoke arm on the other. Halfway between the inner and outer dome is suspended a vertical sheet of iron which is an application of the well-known physical principle that a solid will heat by radiation, while air will not. This sheet is heated by radiation from the inner and outer surfaces of the dome and then

NEW TYPE OF CRAWFORD WARM AIR FURNACE.

gives up its heat to the air by contact. The furnace is so designed that most of the air is forced inside the dome in close contact with the feed section. The fire-pots have heavily-flanged joints. In this, as in some other Crawford warm air furnaces, use is made of a new gear-down construction in connection with the grates, a small gear being mounted on the shank which revolves the larger gears attached to the grate. This permits the grate bars to be made shorter, and keeps the ends of the bars away back from the ashpit door, making it easy to remove the ashes and to shake the furnace. The doors are surfaced by a special machine to give a very tight joint. The latches and hinges are small pieces readily bolted on and changed in case of breakage. This heater is made in four sizes. Size 6 x 9 in. (standard). Pp. 8.

The Guide to Fresh Air is the title of a folder recently put out by the Ohio Blower Co., Cleveland, O., which describes the Swartwout rotary ball-bearing ventilator and contains some interesting data on ventilation. It gives tables of ventilator capacities in cubic feet of air per minute, and dimensions, weights, gauges, etc., of standard ventilators, with a detailed description of their construction. Special attention is given to the glass-top type which combines the functions of skylight and ventilator. The skylight is self-cleaning and no position of the dampers can obstruct the light, when stormy weather necessitates their partial or entire closing. The Swartwout ventilator is mounted on ball bearings. The fact that but one 90-degree turn is made by the air as it is sucked out of the building by the outside breezes is mentioned as one of the important reasons for its high efficiency.

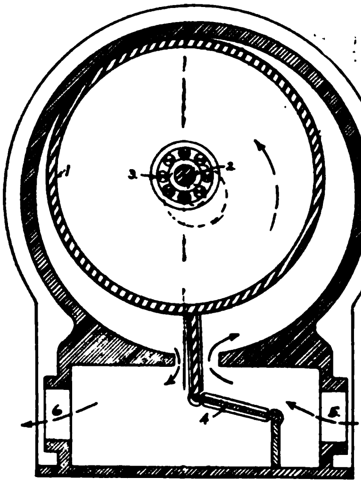
Gurney Down-Draft Boilers, for soft coal, are described and illustrated in a recently-issued circular by the Gurney Heater Mfg. Co., Boston, Mass. These boilers embody all the well-known features of the Gurney Bright Idea water-tube construction, with the addition of a water-tube grate and down-draft principle. The upper grates, it will be noted from the illustration, are hollow and filled with water, which, with the tubes immediately below them are entirely surrounded by fire. The upper grates are of unique and powerful construction. They are cast separate from the boiler and are screwed into the sections. The tubes composing the active heating surfaces are also screwed into the sections with fine machine threads and are made with internal diaphragms to insure rapid and positive water circulation. They are also designed to prevent conflicting currents of water, insure a steady water-line and permit rapid transmission of steam to the piping and radiators. The construction of the upper grates and tubes makes renewal easy, in case of breakage or accident. The circular contains full dimensions, etc., for both steam and water ratings in eighteen sizes. Size 9 x 11 in. Pp. 4.



GURNEY DOWN-DRAFT BOILER FOR SOFT COAL.

Davidson Propeller Fans, which are now made by the Davidson Fan Co., Newton, Mass., this company having acquired from the Massachusetts Fan Company, its rights, good-will and materials, are the subject of a newly-issued circular. These fans, it is stated, are especially useful for ventilating schools, theatres, factories, hospitals, offices, dye houses, bleacheries, etc. Suggestions are included in the bulletin for figuring capacities and other items, and these are followed by capacity tables, for free delivery and for restricted delivery. Size 3½ x 6¼ in. Pp. 16.

McAlear System, described as the biggest forward step in the science of steam heating, is the title of the latest catalogue issued by the McAlear Mfg. Co., 223 West Erie St., Chicago, Ill. This publication is described as not merely a catalogue, but a ready reference book on the McAlear system of vacuum and vapor heating, prepared as the result of 25 years' actual experience. The manual is profusely illustrated, great care having been given to the preparation to the sketches to make them thoroughly clear to the reader. The McAlear electric air line vacuum pump is one of the most interesting features of this system, containing a single propeller which rotates on ball bearings, displacing the air with a rolling motion, eliminating all friction and rubbing surfaces. When in operation, it is stated, neither steam nor water is required to seal these pumps. They are provided with an automatic vacuum controller, starting up when the vacuum drops to 5 in. on the air line and automatically cutting off when the vacuum reaches 10 in. After describing this and the other devices used with the McAlear system, such as the McAlear thermo vent automatic air valve, the Sparks automatic vacuum pump, the McAlear Perfection radiator trap and the McAlear packless graduating valve, the catalogue presents detailed descriptions of the McAlear two-pipe and vapor systems, with numerous drawings of installation details. Size 6 x 9 in. (standard). Pp. 64.

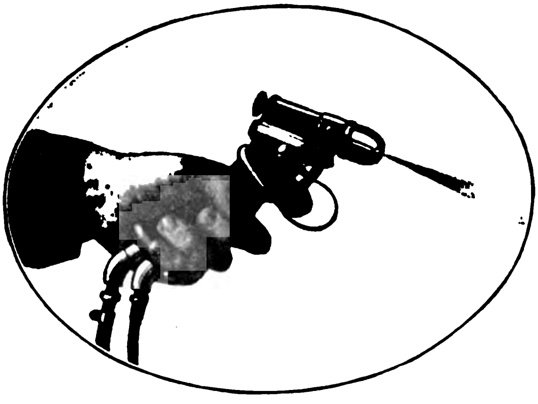


1. Impeller.
2. Crank shaft.
3. Ball Bearings.
4. Hinged Wall.
5. Inlet
6. Discharge.

PRINCIPLE OF MCALEAR ELECTRIC AIR LINE VACUUM PUMP.

Results is the title of a booklet devoted to the Eastman heating system and published by the Eastman System Co., successor to the Eastman Heating Co., 235 Congress St., Boston, Mass. The Eastman system is two-pipe throughout, but uses only one radiator valve. The condensation from each radiator is taken care of by the Eastman automatic plug float valve. This float, being in the radiator, does away with the chambers on the outside of the radiators for floats. This valve is open to air and water, but closed against steam, so that there is no steam in the return risers or return mains. The returns are carried above the water line of the boiler and when the pressure drops the condensation all returns to the boiler, leaving the returns dry. No air valves are used with the Eastman system. The radiators or coils are relieved of air through the return pipes and thence through a vacuum controller to the chimney. The vacuum controller, through which the air is discharged, closes against vacuum and so operates that when pressure is lost at the boiler, a vacuum is formed throughout the entire system. This vacuum draws the vapor from the boiler through the system, retaining the heat in the radiators as long as there is any vapor. When installed on large work, all water of condensation is returned to the boiler through a specially-constructed trap. The circular also presents some of the shortcomings of one and two-pipe systems as generally installed. Size 4 x 8 in. Pp. 8.

Spraco Paint Gun for all kinds of painting, including the painting of radiators, sheet metal work and tanks, is an interesting device illustrated and described in a circular published by the Spray Engineer-

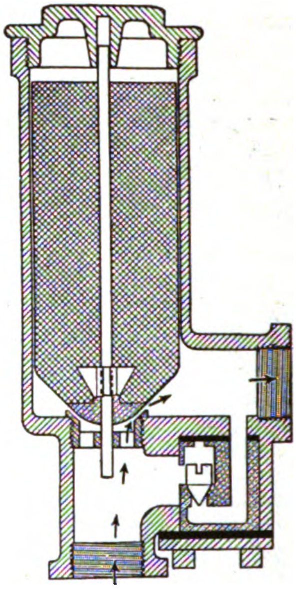


THE SPRACO PAINT GUN.

ing Co., Boston, Mass. The complete equipment consists of a paint gun proper connected by flexible hose to a portable unit combining the material container, air dryer and strainer, pressure control attachment and pressure gauge. After the portable control head has been adjusted to meet the conditions of air pressure, thickness of paint, etc., the operator has control of the outfit by means of the trigger on the paint gun proper. The unit is furnished ready for attachment by a single hose connection to the compressed air supply.

Keeler Water Tube Boilers, manufactured by the E. Keeler Co., Williamsport, Pa., are the subject of a new and well-prepared catalogue. The company, which is in its 53rd year, states that these boilers are offered to discriminating steam users as the produce of over 50 years' experience in constructing boilers of all standard types. The extreme care used in the construction of these boilers, it is added, can only be appreciated by a visit to the company's shops or by an inspection of the completed work. An interior view of the company's standard type is presented with descriptive details of construction and equipment and this is followed by "the argument" which starts off with the claim of superiority of wrought-iron over cast iron or steel for every part of the boiler under pressure. Pages are given up to a discussion of tubes, drums, headers, and baffling, followed by notes on dry steam, circulation and "Requirements of a Modern Steam Plant." The catalogue is profusely illustrated with typical Keeley installations. A series of twelve tests are tabulated in detail and contain some impressive figures regarding the efficiency of the Keeler boiler. The concluding pages take up the cross drum type boiler, the Keeler return tubular boiler, and castings and fixtures. Size 7½x10½ in. Pp. 45.

Clark Temperature Booster, manufactured by W. E. Clark, Ltd., Toronto, Ont., is an unusual device described and illustrated in a recent catalogue issued by this company. The company holds the United States patent, as well as the Canadian patent, and would dispose of the United States patent on suitable terms. The booster, which is intended for use on hot water heating systems, creates a pressure of 15 lbs. on the water contained in the system, causing a more rapid circulation and making possible the use of smaller piping. This extra pressure is accomplished by the weighted valve within the booster. The brass by-pass cage is removable, providing an effective means of freeing the valve of sediment or dirt at any time. The top-shaped check valve and its seat are also removable from the brass by-pass and its cage. The cylindrical case of the booster is made of brass, tapped for 1-in. pipe connections and reinforced at the tappings for additional strength. The weighted valve also has a brass seat, as well as a brass bearing placed in the opening at the bottom of the case, preventing corrosion and assisting perfect seating. Size 3½ x 6 in. (standard). Pp. 12.



CONSTRUCTION OF CLARK TEMPERATURE BOOSTER.

Sturtevant Pneumatic Collecting and Conveying Systems, comprising fan systems for collecting dust and conveying materials, are treated in an impressive bulletin (No. 235 of the Sturtevant Engineering Series) issued by the B. F. Sturtevant Co., Hyde Park, Mass. After presenting the advantages of the pneumatic systems, the catalogue takes up the requirements of various processes, such as wood working, handling dust from tumbling barrels, and sand blast machines, cement plants, and conveying fibrous materials. This is followed by a presentation of Sturtevant apparatus adapted for these purposes, illustrated, in many cases, with views of typical installations, as well as with views of the apparatus itself. Rules are given in detail for the design of dust-collecting systems and this is followed by 13 pages of useful data tables. Size 8¼ x 11 in. Pp. 76.

STURTEVANT AUTOFORCE VENTILATORS are the subject of special circular matter which is being sent out by the B. F. Sturtevant Co., Hyde Park, Mass. These ventilators, it is claimed, will displace three times as much air under the same conditions as stationary ventilators of the same size and double the displacement of the regular cowl ventilators. They work on the principle of the steam injector or Hancock inspirator. Any size, it is stated, will be furnished to meet requirements.

DOWN-DRAFT SYSTEM OF SMOKELESS COMBUSTION, featuring the product of the Prudential Heating Co., Akron, O., is treated in an interesting manner in a new catalogue issued by this company. As one of the pioneer manufacturers of boilers designed for smokeless combustion, this firm has reached the position where its persistent policy has been more than justified. The Cripps down-draft boiler, which is the subject of this catalogue, is designed to burn soft coal of any grade with the elimination of the smoke nuisance. The fire pot, it will be noticed, occupies a position in the center of the section, operating in conjunction with the ordinary up-draft fire at the base of the boiler. By uniting the two fires the combustion, it is stated, is practically smokeless and 90 per cent of the time with practically no smoke at all. Attention is also called to the increase in boiler efficiency offered by this construction, the grate area and actual fire surface being figured as 75 per-cent more than that usually found. Price lists and capacities for all sizes are given, followed by an interesting discussion on "Chimneys vs. Combustion."

THE TELETHERM, described as something every school building should have, is a product of the American Teletherm Co., Toledo, O., which is shown in a recently issued catalogue. The teletherm is an instrument connected by means of electric wires to electric contact thermometers in each school room, and is designed to transmit to the janitor the exact temperatures of the rooms. The instrument is placed in the basement conveniently close to the heating apparatus, and at regular intervals the janitor is expected to take a reading of the temperature of each room. He does this by pushing the buttons in turn as they correspond with the various rooms. The temperature of each room is indicated by the arrow on the dial of the instrument and a permanent record is made on the chart provided for that purpose. Thus the janitor has possession of the information necessary to regulate the flow of air to the different rooms at the required temperature. In connection with the use of the teletherm there is provided a system of mixing dampers for equalizing the heat supply from one central point. The instrument is also described as a fuel-saver in preventing waste due to overheated rooms.

◆

New Book.

HEATING AND VENTILATION, by Louis Allen Harding, B.S., M.E., and Arthur Cutts Willard, S.B., is the title of an important new work for engineers and architects, comprising Volume 1 of what will be a series of volumes on "Mechanical Equipment of Buildings." The work, however, is complete in itself, while Vols. 2 and 3, now in preparation, will deal with power plants, elevator, lighting systems, refrigeration plants, sprinkler systems, vacuum cleaning and plumbing. In its scope and general treatment of the subject the volume on "Heating and Ventilation" easily takes rank with any of the previously-published works on the same general topic. In addition the authors have drawn freely on all available sources of information relating to this field of engineering and have made extensive use of manufacturers' data in designing the various mechanical systems or plants required in modern buildings. In this respect alone, the work represents the latest and most approved practice. Moreover the extensive training and experience of the authors have enabled them to select their data with a fine discrimination, so that the reader is really getting the accumulated notes, including much original matter, of these two engineers.

Among the many notable features of this work, special mention should be made of the number and uniform character of the illustrations, the great number of these, in many cases, requiring insert sheets to contain them all.

Unlike the ordinary manual on heating and ventilation, the volume devotes the opening chapter to physical units and measurement of heat, while the second chapter is given over to a consideration of the fundamentals of water, steam and air. The authors then take up modern heating practice in its various phases. A chapter is included on electrical heating, while another chapter gives a digest of the ventilation laws now in force. Air conditioning is given the place it deserves and central or district heating is adequately treated in a long chapter on the subject. The book contains no less than 615 pages, measuring 7 x 9¼ in. There are in all 543 illustrations. The book is handsomely bound in leather and sells for $4.00. Published by

John Wiley & Sons, New York, and may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

◆

Business Chances.

Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., for the following-named work (drawings and specifications may be obtained from the custodian of the site or from the Supervising Architect):

Until December 22, 1916, for the construction complete of the U. S. Post Office at Bakersfield, Cal.

Until December 26, 1916, for the construction of the U. S. Post Office at Mt. Carmel, Ill.

Until December 27, 1916, for the extension, remodelling, etc., of the U. S. Post Office and Court House, at Oklahoma, Okla.

Until December 27, 1916, for the construction of the U. S. Post Office at Laconia, N. H.

◆

Tracing a Drawing Without Tracing Cloth.

Tracing cloth is affected by the amount of moisture in the air, and for that reason it is occasionally desirable to transfer a drawing to ordinary paper. This may be accomplished by the use of a glass top table beneath which are suspended several strong (60 to 100-watt) incandescent electric lamps. The strong light passes through the drawing and the superimposed paper on which the tracing is to be made. Where blueprints are desired a thin white paper can thus be used instead of tracing cloth and at less expense.

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Open Window Day in New York.

The New York City Department of Health has begun a campaign for more fresh air in sleeping rooms, incidentally combating the prejudice which, it finds, still exists against "night air." The department set December 4 as "Open Window Day" in an effort to promote a more general adoption of the practice.

◆

Lloyd W. Young, for several years advertising manager for the Bishop-Babcock-Becker Co., Cleveland, O., has resigned to engage in the advertising business under his own name, as an "advertising counselor." Mr. Young has taken offices in the 1900 Euclid Building, Cleveland.

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